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Sanitary standards for the felt hatting industry

[Trenton, N.J.]

1915

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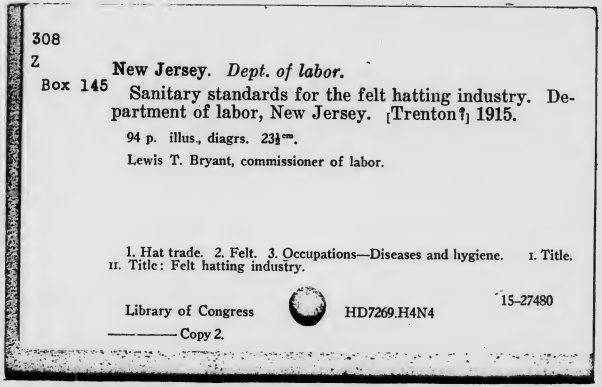

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SANITARY STANDARDS FOR THE FELT HATTING INDUSTRY 1915

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·PUBLISHED·BY·THE·DEPARTMENT·OF·LABOR·
·STATE·OF·NEW·JERSEY·
LEWIS.T.BRYANT, COMMISSIONER

SANITARY STANDARDS

FOR THE

FELT HATTING INDUSTRY

DEPARTMENT OF LABOR
NEW JERSEY
1915

Pub 10-16-25

INTRODUCTION.

Should modern industry accept the old doctrine that there are certain "inherent risks of occupation"?

Should employers of labor be satisfied with a diminished, or inferior, output, due to the lowered vitality of their workers?

Should the worker himself be content to give a physical toll in addition to his daily labor?

Should society be called upon to assume the burden of supporting thousands (and their dependents) whose earning capacity has been wrecked by mechanical hazard, or by hourly subjection to health-destroying processes involving exposure to dangerous dusts, fumes, or excessive heat?

The answer of the twentieth century to all these questions is an emphatic negative. Humanity and business common-sense alike endorse the industrial policy of human conservation. But the reactionary influence of trade custom is still a dominating factor in many of our older factories, and inherited tolerance and lack of incentive sometimes tend to perpetuate methods which are not only a menace to the workers, but often a distinct disadvantage both to employers and to the community at large.

In its efforts to safeguard the health of New Jersey's half million workers, the Department of Labor is mindful of the necessity for combining sound business principles with the best scientific standards now operative abroad and in this country. Arbitrary changes are less advantageous than those which are accepted in a spirit of co-operation, and which are based on a recognition of the necessity for the reforms advocated by the Department's Special Investigators.

In the hope of promoting this spirit of co-operation on the part of those engaged in manufacturing processes offering sanitary problems of peculiar difficulty, the Department has in preparation a series of Bulletins; which it feels will not only prove helpful in establishing the claims to protection of certain workers who have been too long sacrificed to supposedly "necessary hazards", but will also enable employers to compare their own methods with the latest hygienic standards now prevailing in their respective trades.

In publishing the pages which follow (dealing with all phases of the Hatting Industry) the Department feels there is cause for congratulation in the fact that it can record such notable achievements along the line of dust and steam control, and improvements in general sanitation. And it desires to express its appreciation of the growing interest manifested in its efforts to standardize an occupation so long regarded as inevitably health-injurious; but which it now confidently expects will eventually be promoted to the "Non-hazardous" list of New Jersey's established industries.

LEWIS T. BRYANT,
Commissioner of Labor.

July, 1915.

FOREWORD.

Four enemies to the health of the worker, until recently unchallenged, have long haunted the hat shops of America: mercurial poisoning, tuberculosis of the lungs, humidity and bad sanitation. That these health hazards are not myths is established by the fact (which is a matter of common knowledge in the trade) that several of our largest insurance companies refuse to insure fur cutters, makers, starters and sizers at any premium; and that workers in other departments are charged an extra heavy premium on ordinary policies. The Knights of Columbus in Connecticut likewise have excluded certain classes of hatters from the benefits of fraternal insurance.

It is the purpose of the Department of Labor to bring to the attention of the employers and employees in this industry the various means of proved value (devised and tried out by practical hatters in different factories of the Orange Valley and Newark, N. J., Danbury, Conn., Philadelphia, Pa., and Fall River, Mass., as well as by the experts of the Department) for reducing to a minimum these four evils, which manufacturers and workers alike are interested in wiping out. (See Appendix).

FUR AND FELTING.

Fur is the material from which felt hats are made. A glance at the structure of a single fur-fibre under a powerful microscope at once makes plain the secret of its remarkable felting properties. It is not the smooth, soft filament that it appears to the touch and to the naked eye; but a barbed shaft covered with scales like those of a fish. The free upper edges of these scales all point toward the tip of the hair, and away from the bulb at the root.

So long as fur-fibres lie with their roots all the same way, as they do on the body of the animal, they slide over one another without interlocking. But as soon as they are cut from the pelt and thrown together, some will point one way, some another, and the scales will interlock. Each fibre moves in the direction of its root-end, gripping on all the opposing scale-points of other fibres; as the head of wheat or barley which small boys love to put in their coat sleeves, moves up the sleeve as the boy works his arm upon the barbed beard of the grain.

If one works and squeezes a handful of wet fur (in the words of John Thompson, an American hatter who wrote in 1868) "a friction is produced upon every member composing the mass; a footing as it were is obtained from the scales of each, and the fur or wool being all bent or curled, a progressive motion goes on, interlocking each other in their travels, resulting in a compact, dense body which may well challenge the Goddess of both Patience and Perseverance to undo. Every hair has been traveling in its own individual direction, boring, warping, grasping, holding, and twisting amongst its fellows like a collection of live worms."

The felting of fur is a process far older than St. Clement, the Hatters' Patron Saint, to whom an ancient legend credits the discovery of felting through putting a handful of wool into his sandals to ease his weary feet. On taking them off at nightfall the wool was found to be matted into a solid felt. The principle may well have been discovered by some such accident; but it is certain that nomadic herdsmen knew and used the process before the art of weaving was dreamed of, and ages before the days of the good priest.

Fur and wool will felt, then, if merely worked when moist. Hot water quickens the process: and there are various chemicals which act upon, and partially dissolve the scales lying flat along the shaft of the hair, so that the free edges of the scales open, as the scales of a pine cone open out in ripening. Probably without knowing anything of the microscopic structure of a hair, some practical hatter long ago

discovered that fur so treated felts much more readily than untreated fur. "Carrotting," or brushing the pelt with a highly poisonous solution of nitrate of mercury, was practiced in the eighteenth century, and is the process by which fur cutters today open up the scales of the fur-fibres, so that they can grip and work the better to form a hard, tight felt. (See Plate I.)

The fact that the root of a hair forms a bulb considerably larger than the shaft, determines why the fur must be cut from the pelt and not pulled. When you pull a fur-fibre or hair from the skin, the root comes with it; and as the scales force the fibre to move root-end foremost, it must work at considerable disadvantage because of the blunt and swollen working head which it must force in amongst its fellows in the felt—an arrow tipped with a potato. (This fact is utilized in making non-shrinkable woolen goods). The hatter, therefore, who desires to obtain the full contractile force of his felting material, cuts the fur from the pelt with a sharp knife, thereby giving the individual fibre a boring point to ease its insinuation into the mass.

To understand other processes of fur cutting and blowing which will be described later, it is necessary to distinguish between the fur and the overhair of any pelt. The fur is short, fine and downy; the hair coarse, long and much stiffer. Both are alike in general structure; but the hair felts so poorly that it is usually either pulled out before the fur is cut, or at least the coarse tips clipped off; though in certain cheaper grades of fur (killed at the season when the hair is short) the pelt may be cut without either pulling or clipping the hair.

Wool differs from fur and hair, of which we may regard it as a variety, by being more elastic, flexible and curly; and because the structure of its scales is such that it mats and felts even more readily than fur. A considerable though cheaper grade of the hatting industry is based on this material.

It follows that if the barbed structure, which is the secret of felting, is characteristic of all fur, hair, wool and down, there will be many species of furry animals whose coat is fit material for a hat. But if various pelts are chosen for experiment, the finished hats will be very different one from another; for the fur of each variety of animal produces a different result, when worked into felt. Different lengths of fibre (even from the same animal) or different diameters, age, locality, altitude, latitude, manner of killing, length of time before skinning, and length of time the fur is kept in certain conditions of temperature and humidity, all play important parts in determining the value and workability of the fur.

In the history of American felt hatting, the pelt of the beaver easily ranks first. No better material for a hat exists. Hunted from the streams of our northern states, however, the cost of the Canadian pelts has reached a price prohibitive for all except a few of the finest hats now made. Nutria, another very valuable hat material,

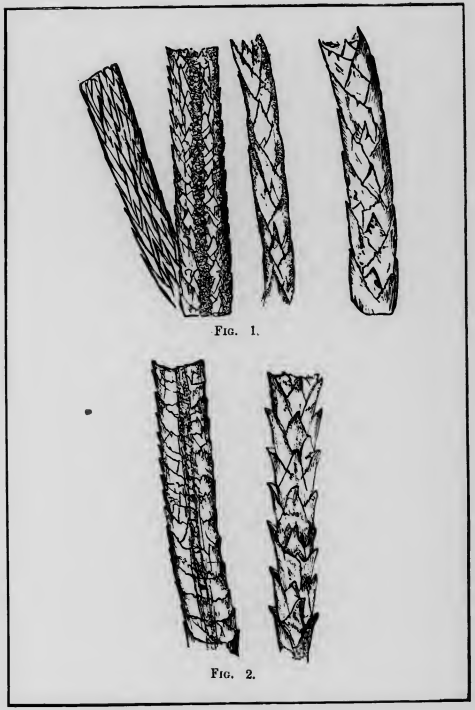

FIG. 1.

FIG. 2.

PLATE I.

Figs. I and II Respectively Illustrate Fur Fibres from a Hare Before and After Carrotting.

D. Van Nostrand Co.

the fur of a South American rodent resembling a small beaver, has also become so scarce that Argentina has put prohibitive restrictions on their killing, and it is now practically out of the market.

The vast bulk of hats produced today are made from the rabbits of Great Britain, Australia, Tasmania and New Zealand; and from the hares and rabbits of France, Belgium, Germany, Austria, Russia and northern Italy. The fur of the hare makes a finer hat than that of the rabbit; but the difficulty lies in obtaining a sufficient quantity. The rabbit is the only fur-bearer whose reproductive activities keep pace with the caprices of changing fashion in the headgear of man. The wild rabbit of Scotland heads the list for quality; with the American rabbit at the foot, chiefly owing to the prevalence of hair in its fur. The fur of the Australian rabbit is longer than the Scotch, but much weaker. Since the fur of each pelt differs according to its location on the body, it is sorted after cutting into backs, sides and bellies; the backs of land animals having the greater value because of the fineness of the fur. With water animals, on the other hand, the belly fur is always finest.

The costly pelts of mink, muskrat, squirrel and seal, although suitable for felting, are used for cloaks and trimmings; and only scraps, from which the fur is cut, find their way into the manufacture of hats. Small quantities of these, called "Furriers' Waste," are used for filling-in on account of their fine quality. This waste works in with the other fur-fibre, and makes the body more compact and finer in texture.

No exact figures are available showing the number of skins imported into America, but the enormous total (some 70,000,000) may be indicated by the fact that there are from two to four ounces of fur in a light weight hat, some heavy sombreros running up to seven and eight and even nine ounces; while there is only a trifle over an ounce of fur in an average rabbit's pelt.

FUR CUTTING.

The dry, raw skins, turned inside out and protected against moths and worms by camphor or other preservative, reach the American fur cutter in bales of 200 dozen and upward (measured sometimes by count, sometimes by weight) and for the most part with the hair unpulled.

DAMPENING. If they are opened in the dry and brittle condition in which they are received, pieces of good fur will be lost in the process, so the skins are usually dampened with water first, or occasionally tumbled in damp sawdust.

OPENING. The opener sits at a bench to which is attached an upright wooden fork over which the skin is slipped. The Australian skins come without heads, and the long sharp knife in a deft hand will open from 2,500 to 3,000 of these in a ten-hour day, and also cut off the tails and legs. With English skins it is necessary to cut off the heads in addition, which reduces the output to from 1,500 to 1,800 a day. The better grades of the latter are sometimes stretched by hand after opening.

CARDING AND TUMBLING. To smooth out the little bunches of matted hair—the "dags"—it is customary to card the British skins; the carder going over the skin (spread out on his knee) with a wire brush. To achieve the same result with the less expensive Australian grades, the skins are tumbled in a revolving wire drum fitted with little shelves, which carry them up and toss them about until the fur is loosened. This tumbling process generates great quantities of dust, which makes it imperative that the drums be enclosed and connected with efficient mechanical exhaust ventilation. (See Plate II.)

PULLING AND CLIPPING. If the animal was killed at the time of year when the hair is short, the fur is cut unpulled, and subsequent "blowing" is depended on to eliminate by gravity the heavier hair. In other cases the skin is fed through a machine which just clips off the coarse tips of the hair; the balance being used along with the fur in making the hat. With all the best grades of pelt, however, the hair is pulled before the fur is cut. The old hand method, still largely in use, is to press a rubber thumb against a sharp knife-edge, and pluck the longer hairs from the short, fine fur. The fur-plucking machines shown in the illustration are built on the same principle; dull, rotary knives draw against a rubber disc, the suction raising the hairs so that the knives can grip and pull them out. Some fur is lost with the hair, but the amount is small.

PLATE II.
An Enclosed and Mechanically Ventilated Tumbling Drum. (Gear-Guard Removed)

Courtesy of Donner & Co.

The fur-plucking machine should be fitted with mechanical exhaust ventilation to carry away the hair before it reaches the operative's face. It is a dusty process, unless so safeguarded. (See Plate III.)

Thus far the trade process has involved the handling of harmless raw skins; and hygienic surroundings, dust-control on tumbling, clipping and plucking machines, good washing facilities, simple cleanliness, and the daily sweeping up of the litter about the benches at noon and after work hours, is all that is necessary to insure proper sanitation. Unfortunately, in the smaller fur-cutting establishments, custom has long sanctioned highly unsanitary standards.

CARROTTING. With the carrotting process enters the hazard of mercury poisoning; a menace to health which must be guarded against from now on until the finish of the hat. (See Appendix.)

The carrot (so-called from the carrot-yellow color of the treated skins which have been subjected to heat) is a solution of nitric acid and mercury, commonly 100 pounds of acid to 25 or 30 pounds of mercury, although the proportions vary in different shops. In some shops it is the custom to mix every day, using heat to quicken the combination. The better practice is to let it stand from three to five weeks before using. This is not only a trade advantage, but also lessens the mercury hazard not only for the "carrotters" but all subsequent handlers of the fur.

To allow open containers to stand in the workshop, or to boil the carrot in the shop at night, is to deliberately endanger the health of the workers. The mixing should be done out of doors, and the containers stored in mechanically ventilated chambers such as the one shown. The recovery of the fume in water (rather than throwing it off into the air) has both sanitary and economic advantages. (See Plate IV.)

Before using, the nitrate of mercury is diluted with about twenty volumes of water. In applying it by hand, the skin is held fur side up upon the carrotting bench with the left hand, and the carrot applied with a brush. It is essential that the carrotter wear rubber gloves: that the bench on which he works be of impervious smooth material, slanting away from the worker, and drained by a waste pipe; and that an ample hood connected with mechanical exhaust ventilation be placed above the table to carry off the constantly generating fumes. Rubber gloves are generally in use at present, and one seldom sees the black hands and yellow nails of those ignorant or fool-hardy enough to work in the acid unprotected. Three durable substances are in use for table tops: flag stones of slate being reported preferable, although certain English shops use an earthenware slab; and tar has been found to resist disintegration by the acid. Cement rapidly disintegrates and cannot be used. The rough wooden benches, perpetually soaked with the carrot, which are found in the poorer shops, are intolerable from the sanitary standpoint. No further argument is needed for ventilating hoods

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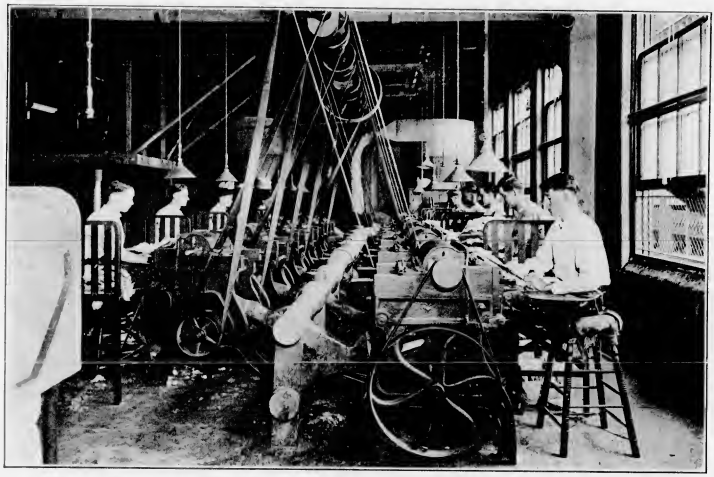


PLATE III.

A Battery of Clipping and Fur-Plucking Machines with Mechanical Exhaust Ventilation.

Ridgway Co. Courtesy of John B. Stetson Co.

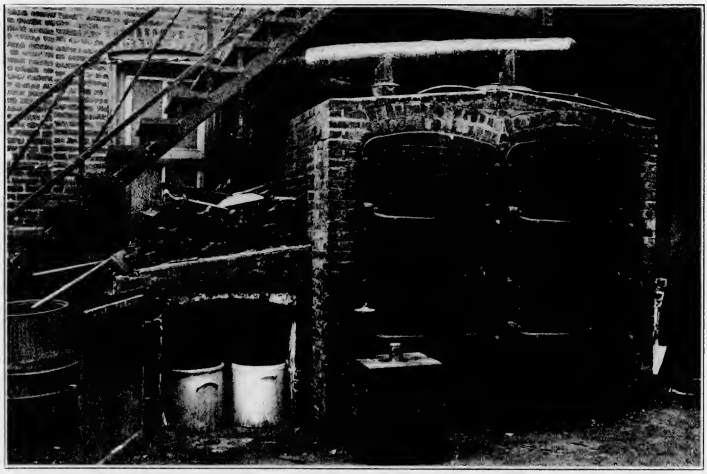
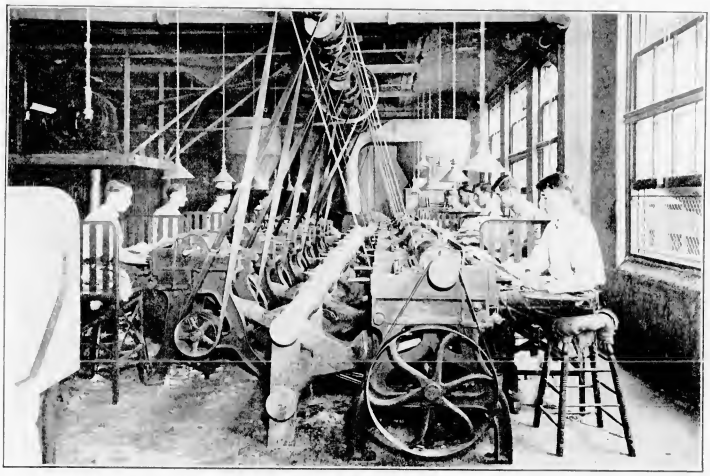


PLATE IV.

Open Air Chamber with Containers in which Nitric Acid and Mercury for Carrotting are Mixed and Stored.

Ridgway Co. Courtesy of C. M. Hedden Co.



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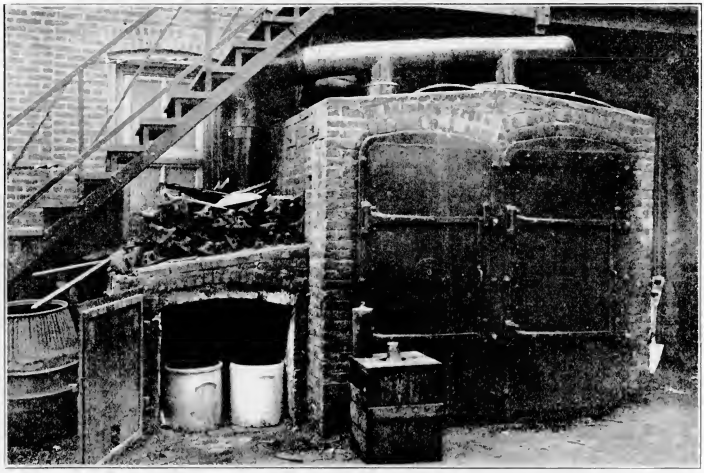

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above the carrotting-tables than the blackened teeth, salivated gums, and occasional "shakes" of many of those who now work day in and day out in a poisoned atmosphere, which science has proved is inevitably injurious, however slight the fumes appear to be.

Two thousand carrotted skins is considered a good day's work of ten hours of hand labor. On a machine-brushing device as many as 5,000 or 6,000 can be carrotted. The machine work, as at present operated without mechanical exhaust ventilation, however, is hazardous to the operative because of the fine spray of nitrate of mercury which is thrown off by the revolving brushes. The worker breathes an atmosphere even more saturated with the poisonous liquid than in the case of hand-work; but an efficient mechanical ventilating hood over the machine-brushes is capable of greatly reducing the physical risk.

DRYING. Immediately after carrotting the skins are dried. If a white carrot is desired for light colored hats, this is done by spreading the pelts somewhere indoors where the skins will dry very slowly, preferably without artificial heat. It should be borne in mind that fumes are given off during the operation, and that where the floor of a whole room is covered, good natural or artificial ventilation is required. Usually the skins are dried quickly, by artificial heat, which produces the yellow color that has given the "carrot" its name. The fumes from the drying skins are as dangerous as any encountered in the process of hatters' fur-cutting, and it is imperative that either exhaust ventilation, or a powerful natural draught, be provided to carry them off. A good type of ventilated oven for a small establishment is pictured in the accompanying plate. (See Plate V.) Where endless wire aprons traveling through heated chambers are used, ventilating hoods should be placed at either end of the chambers, which should be of tight construction throughout their length to prevent fume from escaping into the shop.

BRUSHING. Before cutting the skin from the fur, the dry, carrotted pelts (usually slightly dampened to prevent cracking) are put through a brushing machine to smooth out the matted hair and dags, so that the fur will later come from the cutter with each filament separate. This brushing generates a highly dangerous dust, heavily charged with crystallized nitrate of mercury. The machines should always be hooded with powerful exhaust ventilation, so that all resulting dust may be carried away before it reaches the worker's face. (See Plate VI.)

CUTTING. After brushing, the pelt is fed in against rapidly rotating knives which cut the skin from the fur; the former dropping down in fine shreds appropriately termed "noodles," and the fur coming out on a tray in the exact position in which it grew upon the pelt. This, too, is a dusty process, and should have mechanical exhaust hoods on the machines. This is the only operation in the fur-cutting shops in which accidents occur, unless protected by a safe-

PLATE V.
A Satisfactory Type of Small, Ventilated Drying Oven, Free From Fume.
Courtesy of C. M. Hedden Co.

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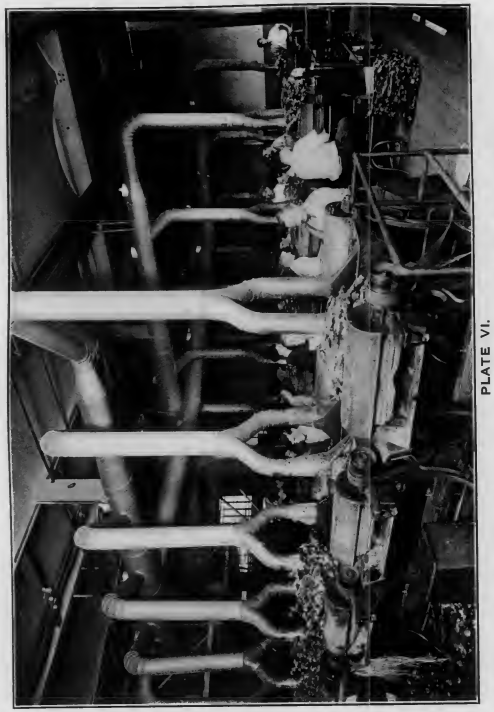

PLATE VI.
A Battery of Brushing Machines with Mechanical Exhaust Ventilation.
Courtesy of John B. Stetson Co.
Ridgway Co.

guard; pieces off the ends of fingers are not uncommon, and sometimes a hand is lost if the operator reaches into an unguarded machine to pull a skin. (See Plate VII.)

SORTING. As has been explained, the fur from different parts of the hare or rabbit possesses different qualities and value, the backs being the finest and strongest. Unpulled fur is not divided. But all the better qualities are sorted as the fur comes from the cutters into backs, sides and bellies in the case of hare; and into backs and sides of rabbit (the "sides" including bellies, cheeks and tails). This sorting is done by young girls and women, and is a dusty occupation involving exposure to mercury. Vacuum cleaning of the room or wet-sweeping out of work hours, and the provision of washing facilities, dressing, and lunch rooms, is imperative.

SACKING AND STORAGE. The final process in the fur-cutting shops is the sacking of different qualities, in paper bags each containing five pounds. In this form it goes from the fur cutters to the hat makers. These sacks must be stored either in ware-houses or factories, and it is necessary that the store-rooms be well ventilated, as the atmosphere is always charged with mercury fumes highly injurious to the men who must work there. As wood absorbs the fume, brick or concrete storerooms are necessary; movable shelves or racks for the bags should rest on iron supports, and be preferably of metal; if of wood, they should be burned and replaced annually.

BY-PRODUCTS. The shredded pelt from the cutting machines, the "Noodles," is converted into glue and sizing. In France it is clarified and made into gelatine. This waste should be gathered up from the machines daily and stored in dust-proof bins.

In England the hair is used, to a certain extent, by the poorer classes in making beds; in America it has found some use as a filling for cheap upholstered furniture, and for tumbling-mattresses used in circuses.

BLOWING ROOM. One of the most obstinate dust problems in the fur-cutting trade is found in the Blowing Room. Here the marketable hatters' fur (found in tails, pieces, snips, raw pullers' pieces, felt, and the odds and ends of sweepings) is reclaimed from the dirt and refuse destined for the fertilizing plants. In addition, thousands of pounds of valuable cuttings from fur-dressing establishments, and from the work-rooms of the makers of fur coats, sets, and fur trimmings, also find their way to this department.

The bales are opened up, and the contents fed into an automatic feeding machine from which it passes through a chopper, and thence to a two-section blowing machine. This presents something of the appearance of a wooden "prairie schooner" with a rounded wire-mesh top. Each compartment forms an enclosure with wooden walls: the floor being formed by an oilcloth traveling apron, with a fine-toothed picker shaft revolving rapidly at the front end. The

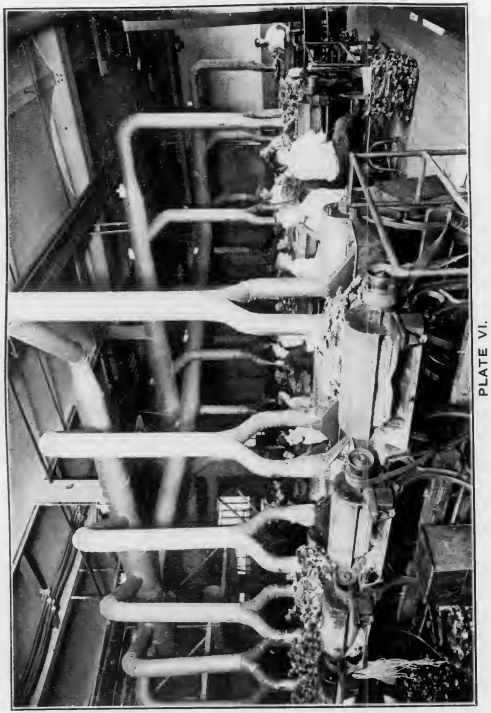

PLATE VI.

A Battery of Brushing Machines with Mechanical Exhaust Ventilation.

Courtesy of John B. Stetson Co.

Ridgway Co.

guard; pieces off the ends of fingers are not uncommon, and sometimes a hand is lost if the operator reaches into an unguarded machine to pull a skin. (See Plate VII.)

SORTING. As has been explained, the fur from different parts of the hare or rabbit possesses different qualities and value, the backs being the finest and strongest. Unpulled fur is not divided. But all the better qualities are sorted as the fur comes from the cutters into backs, sides and bellies in the case of hare; and into backs and sides of rabbit (the "sides" including bellies, cheeks and tails). This sorting is done by young girls and women, and is a dusty occupation involving exposure to mercury. Vacuum cleaning of the room or wet-sweeping out of work hours, and the provision of washing facilities, dressing, and lunch rooms, is imperative.

SACKING AND STORAGE. The final process in the fur-cutting shops is the sacking of different qualities, in paper bags each containing five pounds. In this form it goes from the fur cutters to the hat makers. These sacks must be stored either in ware-houses or factories, and it is necessary that the store-rooms be well ventilated, as the atmosphere is always charged with mercury fumes highly injurious to the men who must work there. As wood absorbs the fume, brick or concrete storerooms are necessary; movable shelves or racks for the bags should rest on iron supports, and be preferably of metal; if of wood, they should be burned and replaced annually.

BY-PRODUCTS. The shredded pelt from the cutting machines, the "Noodles," is converted into glue and sizing. In France it is clarified and made into gelatine. This waste should be gathered up from the machines daily and stored in dust-proof bins.

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PLATE VII.

A Cutting Machine with Mechanical Exhaust Ventilation Connected with a Canvas and Wooden Dust Collector.

Courtesy of Donner & Co.

air currents generated by the picker blow the fur about till it is carried forward into the next compartment; from which it eventually comes out through rollers at the further end, looking like a sheet of gray cotton batting. The dirt, refuse and heavier hair settle by gravity to the bottom and are removed. Not only floating fur, but great quantities of dust are thrown into the air of the workroom during the process; and even more is generated where the discarded material from the first blowing operation is fed into a "grinder," and thence to a second blowing machine. While it is true that over 80% of the fur so treated is "raw" (uncarrotted), nevertheless it is impossible to exaggerate the discomfort of the worker in this department, or to ignore the serious hazards to throat and lungs caused by breathing the highly irritating dusts.

It is to be hoped that experiments now being conducted may shortly revolutionize this process. Where the present method is followed, however, the mechanical exhaust installation pictured in Plates IX., X. and XI. reduces the dust problem to a minimum, and effectually protects the health of the workers.

ROUNDING DEPARTMENT. (Sometimes found in fur-cutting establishments).

This Department reclaims the fur from the "roundings" shipped from hat factories. These are parings of felt, cut from the excess hat-brim by the finisher's "rounding-jack," when he cuts the brim to its required width (after which it is curled and bound with ribbon).

The bales of "roundings" are opened up; the contents boiled in a vat (which should be hooded to pull off the steam fumes) to dissolve the shellac that has been used in stiffening the brims from which the "roundings" are cut; and after treatment with this bath of diluted ammonia and caustic soda, a chemical is added to the boiling vat that practically removes all traces of dye. The "roundings" are now dried with a cyclone dryer; thrown into a tearing machine whose pickers loosen the matted, felted fur-fibres; fed into a teasing blower which separates the fur from the dust; and finally fed into a six-section blowing machine, from which the finished product is ready for re-shipment to the hat factory, while the dust goes to the fertilizing plant.

While there is no mercury risk in this Department, it far exceeds the blowing-room proper in the quantity of dust generated. Mechanical exhaust installation such as that later described and illustrated in Plates IX, X, and XI, is imperatively required to protect the health of the operatives.

The fact that the majority of employees in our fur-cutting establishments are immigrants (many of them young girls and women) ignorant of the health-hazards to which they are exposed, and receiving too low a wage to insure good food and living conditions, should be borne in mind in estimating the employer's responsibility to safeguard his workers from the recognized dangers of the trade.

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While this class of labor is commonly too shifting to furnish complete data as to occupational illness, enough exists to warrant the enforcement of all the precautionary measures now operative in our best plants.

The fact that a few "physically immune" workers seem able to resist for years the effects of poison or lung-irritating dusts, is no argument for the continuance of unsanitary practices. It is not the occasional employee, with ten or fifteen years to his credit, who should fix the hygienic standards of this or of the hatting trade; but rather the ten or fifteen bread-winners who have been wrecked by unnecessary exposure to conditions they were constitutionally unable to combat, and whom the factory has thrown upon the community either infected with induced consumption, or helpless from the effects of acute or chronic mercurialism.

SUMMARY OF SANITARY STANDARDS.

To make fur-cutting a reasonably safe and sanitary occupation, therefore, shops should observe the following requirements:

1. Enclosure, and standard exhaust ventilation on tumbling drums.
2. Standard exhaust ventilation for the fur-plucking machine.
3. Mixing the carrot outside the shop.
4. Storing the carrot in ventilated chambers.
5. Rubber gloves and impervious aprons for the carrotter.
6. A drained bench of impervious material slanting away from the carrotter.
7. Ventilating hood with efficient exhaust above the carrotting table for both hand and machine work.
8. Efficient draft to carry off all fumes from drying ovens.
9. Standard exhaust ventilation on the brushing machines.
10. Exhaust ventilation on the cutting machines.
11. Mechanical exhaust ventilation on all blowing machines.
12. Removal of steam by means of ventilating hoods from all boiling-tanks in the treatment of "roundings."
13. Mechanical exhaust ventilation on all tearing machines, teasing blowers, choppers and grinders.
14. No raising of the temperature of the workroom above 60 degrees by means of artificial heat.
15. Wearing of overalls and head coverings.
16. Abundant natural or mechanical ventilation in the storeroom for sacked fur, and wherever "white-carrotted" skins are drying.
17. Daily gathering up of all waste, vacuum cleaning or wet sweeping of the whole shop at noon and after work hours daily.
18. Separate washing facilities for both men and women, with hot and cold water; modern toilet accommodations; and pure, cool drinking water, preferably bubbling fountains.
19. Separate lunch-rooms outside of the rooms where mercury and carrotted fur are handled.
20. Warning notices (such as this one posted in certain English shops) which would call the attention of workers to the need for cleanliness and personal hygiene:

    "Fur cutters are warned of the danger of mercurial poisoning of which the principal symptoms are soreness of the gums, offensive breath, increase in the amount of spittle, and trembling of the fingers.

    Workers are warned of the danger arising from the chewing of tobacco, and of eating food with unwashed hands.

    Mercury has a tendency to destroy the teeth, and this can be best obviated by the use of a tooth-brush once every day."

FELT HAT MANUFACTURE.

THE BACK SHOP.

While a few of the largest hat-shops cut their own fur, the overwhelming majority buy their material in the five pound bags of graded fur, which we traced as the final product of the fur-cutters. Before it is fit to work into a hat, however, it must go through a refining process to free it from "dags" (bits of fur stuck together by the carrot, and fragments of skin) and the coarse hair which it is impossible to eliminate entirely in fur cutting.

MIXING AND REFINING PROCESSES.

MIXING. Each grade and weight and color of hat requires a different mixture of various kinds of fur. As many as six varieties may be necessary for satisfactory results. It used to be the universal practice (and unfortunately still is in most shops) to layer down a large quantity of fur in a corner of the mixing or blowing room (or in an open bin) and there toss and mix it by hand or with a fork. As this throws a cloud of poisonous fur and dust into the air, the method has been condemned by some of the trade as an unnecessary health-hazard to the mixer. (At present this class of work is usually done by immigrant laborers, who are too shifting to furnish reliable data as to occupational disease. Reference to hospital and dispensary records, however, give authentic cases of mercury poisoning, "the shakes," partial paralysis and suicidal melancholia among mixers.) Several shops report most satisfactory results from mixing in an enclosed, dust-proof bin; with a picker shaft running through it, which is provided with coarse teeth 20 to 24 inches long. A firm handling the finest grades of fur-mixture has substituted machine-mixing for hand layering down. This does the work as satisfactorily and cheaper than hand labor, and keeps the room free from dust and fur. (See Plate VIII.)

Another point to be noted is that economy, as well as good sanitation, sanctions keeping all mixed and blown fur in boxes fitted with tight covers, so that it will not fly about with every current of air. The fire-hazard in a dusty mixing-room is not to be ignored by those familiar with the history of hat factories.

"THE DEVIL." The mixed fur may be preferably run through an automatic feeder (where the visible part of the fur has been compared in appearance to "an endlessly moving strip of a Smyrna rug") or be fed by hand into a conical mixer known as "The Devil," because of

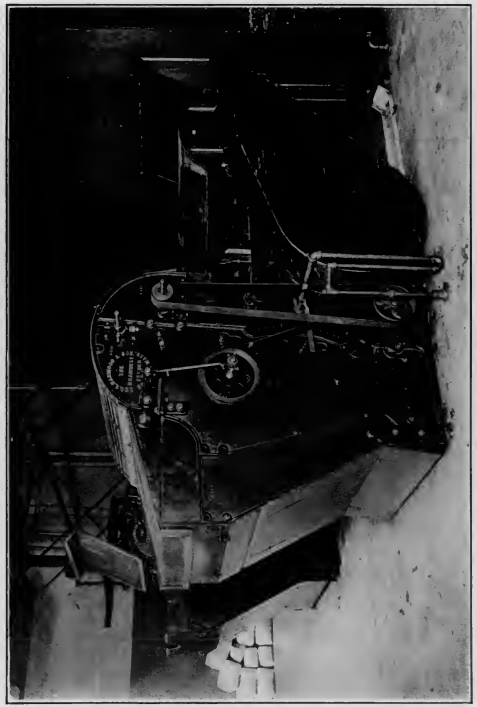

PLATE VIII.
A Machine Mixer Which is a Satisfactory Substitute for Layering-Down and Hand Mixing.
Courtesy of John B. Stetson Co.

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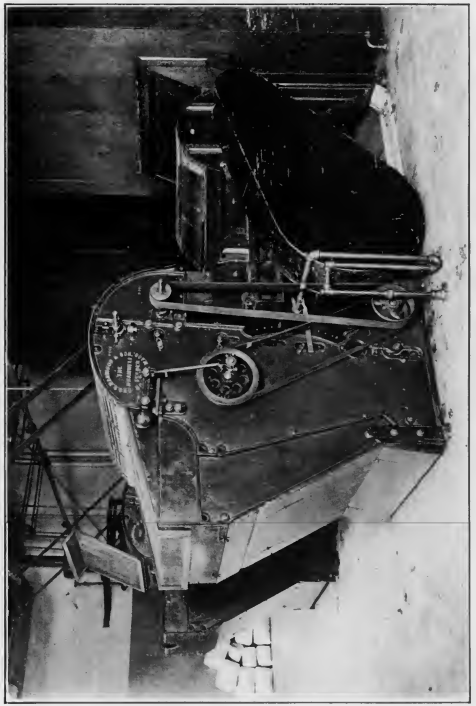

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its wicked steel teeth and their vicious tearing power. These are part of a cylinder-shaft some 18 inches in diameter, which revolves several thousand times a minute; and by tearing the fur until all the fibres are freed and loosened, completes the unification of the blended mixture. In old days, before "The Devil" was safeguarded, many a worker lost fingers, hands and even arms as a result of contact with its dangerous teeth. Today it should still be reckoned as an industrial enemy; not only because of the quantities of mecurialized dust it raises, which must be controlled by tight housing, but also owing to the frequency with which its steel pickers strike out a spark and ignite the fur they are tearing. Ordinarily the fire thus started can be extinguished inside the machine; but if it spreads, and the room is littered with fur from hand-mixing, the difficulty of its control is immeasurably increased.

From "The Devil" the fluffy fur passes into a settling chamber. For sanitary reasons this should be made as dust-tight as possible, by running a coarse cheese cloth covering either inside or outside the wire mesh openings commonly found in ceiling and sides.

Practical experience proves that today "good-housekeeping" is not only possible in the vicinity of "The Devil," but that it is endorsed by both economic and hygienic arguments.

BLOWING. The fur from the settling chamber is not yet wholly free from dust, bits of skin, and other impurities. Before it is fit for felting, it must be still further refined to the lightness of thistledown.

From the boxes of mixed fur which are filled from the settling bins, soft drab masses are fed into an automatic feeder, from which it passes to a blowing machine. These feeders are a great improvement over the old hand method, and may be rendered absolutely dustless by the simple device of fastening fine wire mesh over the feeding-opening commonly left uncovered. While in most blowing-rooms this backing of fur and dust from the feeder is ignored, experiment has proved that not only does it impregnate the air of the work-room, but also an appreciable quantity of the best fur is scattered and must be regathered. (See Plate IX.)

The blowing-machine (which was described in its two-section form in the Fur-cutting factory) consists of the same wooden "prairie schooner" with rounded wire-mesh top. It is perpendicularly divided into sections (commonly six); each compartment forming a separate enclosure with wooden walls; and each with a fine-toothed steel picker-shaft rotating rapidly at the front of the travelling oil-cloth apron, which forms the bottom. The air currents from the series of picker shafts blow the fur about; and as it settles on each of the aprons it is carried over into the suceeding compartment; until at last it comes through the rollers at the end of the machine in a sheet resembling light gray cotton batting, but so downy it falls apart at the touch. This operation is repeated several times with the best grades of fur, to insure the removal of all dags and im-

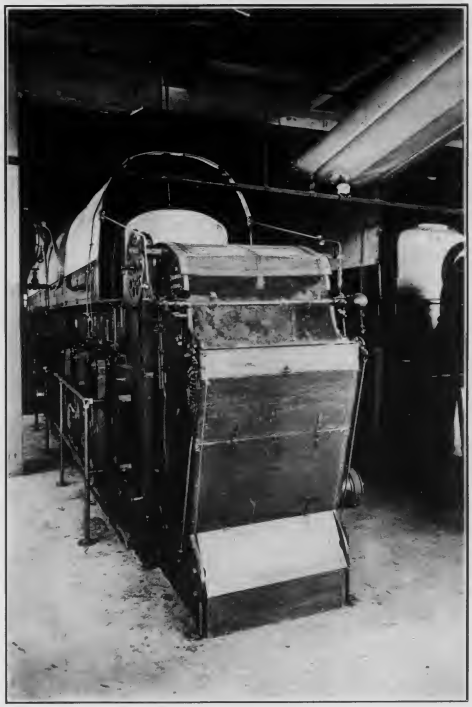

PLATE IX.

An Automatic Feeder (with Wire-Mesh over Feed-Opening) Attached to an Oil-Cloth Hooded Blowing Machine.

Ridgway Co. Courtesy of John B. Stetson Co.

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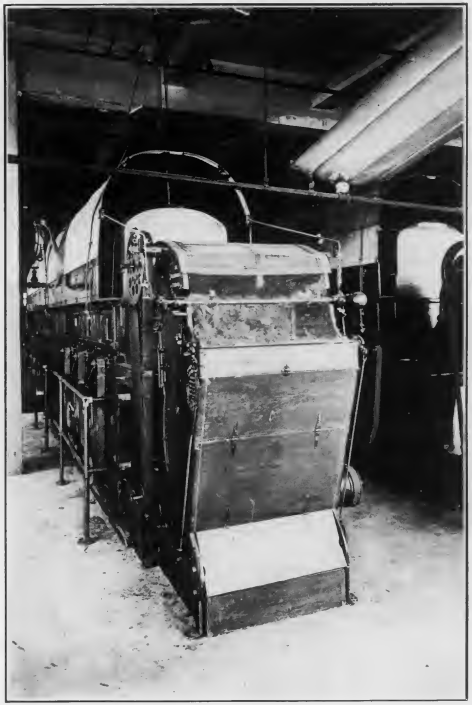

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Ridgway Co. Courtesy of John B. Stetson Co.

purities. These (during the blowing process) settle by specific gravity; then drop through the opening between the picker-shaft and apron, on to vibrating cord-sifters; from which they settle upon the traveling apron running the whole length of the bottom of the machine, and are eventually collected for re-blowing, to insure recovery of the last fibre of valuable fur. (See Plate X.)

No department ordinarily offers more serious health-hazards than the blowing room (both mercury poisoning and consumption) owing to the quantity of carrotted fur and dust thrown out by the machines while in operation. This is augmented by that generated when they are opened by raising the top, and are cleaned out to free the pickers and machinery from clogged fur. Dry sweeping of the floor, walls and rafters is also common, in the worker's almost hourly efforts to keep down the perpetual accumulation of fur and dust. (In factories where "The Devil" and settling chamber are in a corner of the blowing-room, and hand-mixing is practiced, dust conditions are sometimes almost intolerable, and the fire risk is a serious one.)

While mechanical injury is possible on the high-speed belts and wheels driving the picker-shafts (unless the aisles between the blowing-machines are at least 30 inches wide, and even then safeguarding is necessary) the excessive heat and humidity of the average blowing-room is a more serious hazard for the worker. The fact that open windows interfere with the blowing operation (by disturbing the air currents) and set the loose fur flying; and also that a high percentage of humidity is required to insure satisfactory results, has too long warranted foremen in their practice of running live steam into the air of the room, regardless of the resulting high temperature.

It is cause for congratulation that all the health problems of the blowing-room have been solved (with economic advantage) by the superintendent of this department in Philadelphia's largest hat factory.

As may be seen in the illustration, an oilcloth hood (the glazed surface inside) duplicating the actual covering of the "prairie schooner" of the last century, is framed over the wire mesh top of the entire blower (leaving an air space between the two) enclosing it except in front. The rear end of the canvas hood is attached to a mechanical exhaust system, fitted with diaphragm dampers so that any desired pull can be obtained. (See Plate XI.) Between the canvas and wire mesh top are a series of wooden beaters, operated by an attachment to the automatic feeder; which keep the wire free from clogging, and facilitate the throwing out of dust that is carried off by the ventilating system. While blowing the fur, only a gentle draft is maintained, just sufficient to carry off any dust generated; but whenever it is desired to clean the machine, a powerful current can be applied. This is an improvement even over the vacuum cleaning practiced throughout this factory. While the expense of piping an entire plant is often prohibitive, inexpensive and

PLATE X.

An Eight Section Blowing-Machine, Showing Driving-Wheels of Picker-Shafts, and Exhaust-Hood over Wire Mesh Top.

Courtesy of John B. Stetson Co.

Ridgway Co.

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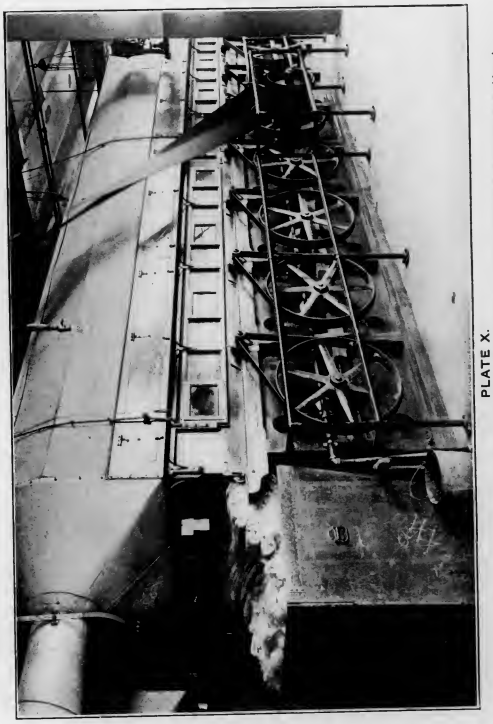

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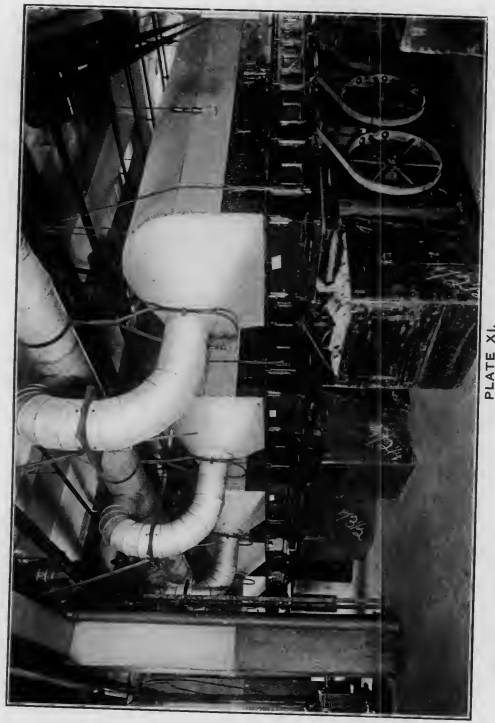

PLATE XI.

Method of Attaching the Hoods to a Mechanical Exhaust System with Diaphragm Dampers.

Courtesy of John B. Stetson Co.

Ridgway Co.

entirely satisfactory portable electric vacuum cleaners are obtainable. These can be operated in all departments during working hours without disadvantage to the workers, and the fur collected can be at once returned to the blowers. The practice of cleaning out the blowing-machines by means of compressed air (thereby sending a cloud of poisonous dust throughout the work-room and necessitating laborious and unsanitary sweeping to recover it) is opposed to modern hygienic standards.

The problems of excessive heat and humidity in the blowing-room have been no less satisfactorily met in this factory than that of dust. (See Plate XII.) As may be seen in the illustration, moisture is obtained by directing a jet of steam at right angles upon a fine spray of cold water, thereby insuring ample humidity with no rise in temperature above the 70° maintained at most seasons of the year. (The excess condensation is caught and drained off in the galvanized troughs seen in the Plate.) Experiments are now being conducted as to the possibility of blowing the steam directly into each section of the blowing-machine, (according as atmospheric conditions may demand) and satisfactory results are reported. The Department urges the use of a hygrometer, or of a wet and dry bulb thermometer in the blowing-room, so that excessive heat and humidity may be avoided. Recent tests have proved that a humidity of 65°-75° is only necessary during the cold season, when the fur is full of electricity; and that the health of the worker is unnecessarily sacrificed when a high degree is maintained at all seasons of the year. (See Appendix.)

Attention may be called to a simple device for ventilating rooms whose temperature must be kept uniform, and free from disturbing drafts. It has been found that the adoption of muslin windows in the lower frames of the ordinary window, is a relief from the dead air common in such places. A medium grade muslin cloth of light color is a better non-conductor of heat than glass; and if it is occasionally renewed does not prevent a free exchange of air, or lessen the diffusion of light.

The tragic history of blowing-rooms, which may be traced in the records of dispensaries and hospitals, as well as the day-books of physicians, together with the indubitable economic advantages of "good-housekeeping," give an especial interest to the recent notable sanitary reforms achieved in this department. As has been pointed out before, the health standards of a process or trade should not be based on the abnormal tolerance of fume and dust of a few workers; whose occasional length of service is more than offset by the pitiful records of the many who have paid their physical toll in incapacity or death.

FORMING THE FUR BODIES.

WEIGHING. From the blowing-room the fur is carried in large boxes, which should be covered, to the "forming" or mill-room. Here

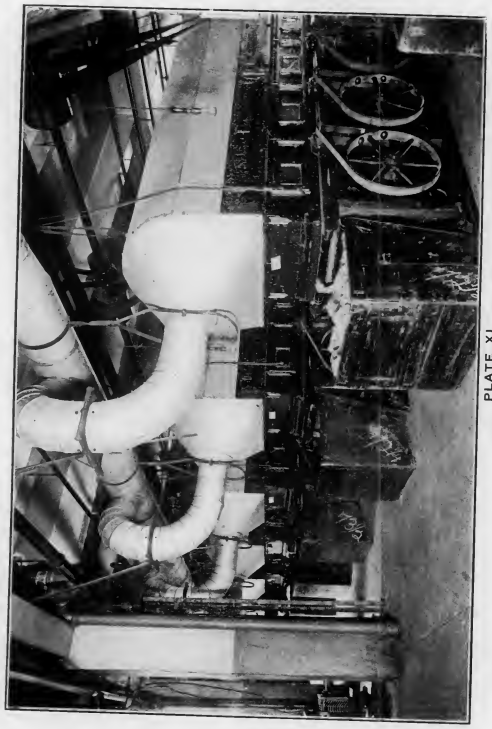

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PLATE XII.
Method of Controlling Excessive Heat by Means of Cold Water Sprays Meeting Humidifying Steam-Jets Above Condensation Troughs.
Ridgway Co. Courtesy of John B. Stetson Co.

girls weigh it out in the quantity required for one hat; putting each scale-full of fur so weighed into small boxes or compartment trays holding one dozen, which are passed up to the "feeder." (This is a dusty, and, therefore, unhealthful process.)

FEEDING. The "feeders" (always women) stand on elevated platforms above the rear of the forming machine. This brings their heads so near the ceiling (which in the majority of cases is lower than the requisite minimum of 14 feet) that they are subjected to great heat (for the mill-room is always kept at high temperature); are forced to breathe contaminated air (owing to the prevalence of mercurialized fur dust); and are further exposed to mechanical hazard from the high-speed belts and driving wheels on the machine (which rarely have other than pipe rail guards) should they faint and fall from the platforms, as sometimes happens.

There are sanitary advantages in the mechanical weighing-and-feeding-machines in successful operation in Massachusetts' largest hat factory; but its employment is only possible where a coarser and uniform grade of fur is handled.

On finer grades hand labor is necessary; but its most objectionable features have been eliminated in the Philadelphia factory already referred to, by the adoption of the inclined double apron, which permits the "feeder" to stand on a platform practically on the floor level. (See Plate XIII.)

FORMING. The fur deposited by the "feeder" on the traveling apron is drawn by powerful fan-suction, and deposited upon a rapidly revolving cone of perforated sheet copper, about 30 inches high and slightly dampened. This rotates inside a balloon-shaped wooden housing (uncovered at the top) with large double doors opening in front. (See Plate XIV.) Although these usually have small glass windows, through which to watch the operation, the "coner" rarely closes the doors until the forming process is well started (to discover any irregularity in air currents and possible imperfections in the fur body being deposted). This practice is largely responsible for the ill health of not only the "coners" themselves, (mercurialism and consumption) but by their freeing the whirling fur-dust, the entire air of the work-room is contaminated. In addition there is generally a distinct loss in schedule-weight of the fur-body which, in high grade hats, becomes a serious defect. A few foremen have succeeded in inducing their "coners" to reduce this dust exposure to a minimum; claiming that there is no actual necessity for so unsanitary a practice; and that it is merely a bad trade custom, both injurious to the worker and wasteful from an economic standpoint. (It is to be noted that this powerful suction draws considerable fur through the fan of the forming machine into a recovery-bin, situated either below the machine or in other convenient location. This fur is returned to the blowing-room after its collection. Much depends upon the proper relation between the pull of the fans and the release of air from the

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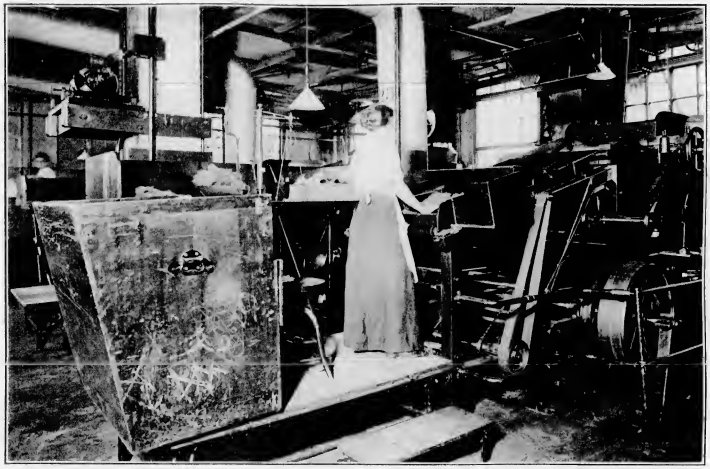


PLATE XIII.

Forming-Machine with Inclined Double-Apron Attachment, Overhead Mirror, and "Feeder" Standing Practically on Floor-Level.

Ridgway Co. Courtesy of John B. Stetson Co.

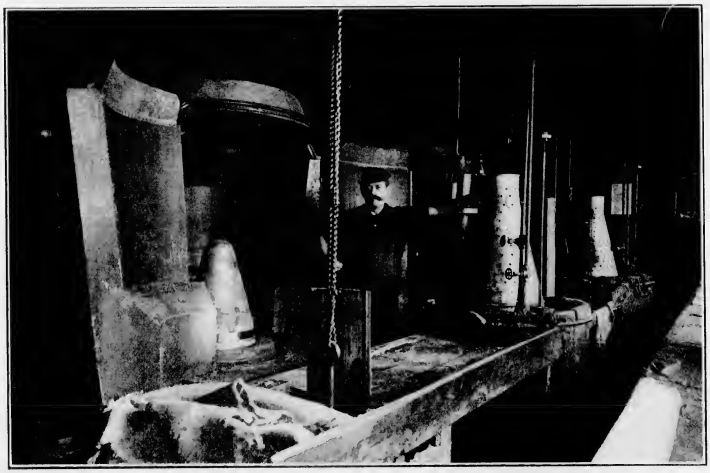
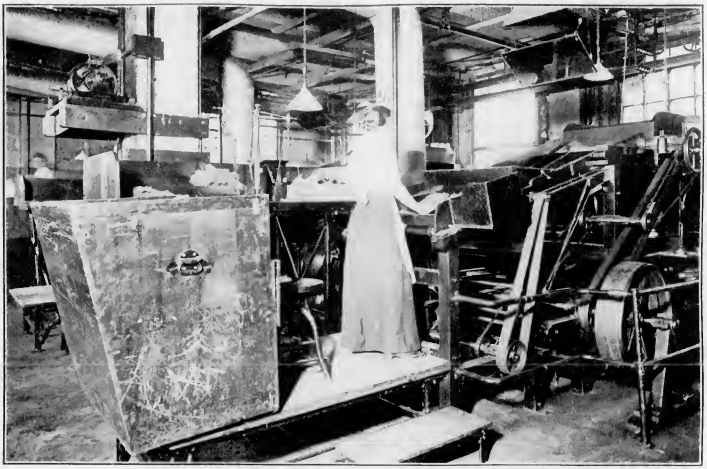


PLATE XIV.

Forming Machine with Doors Open, (Showing Copper Cone) and Self-Sinkers with Covered Cones on Racks.

Ridgway Co. Courtesy of Joseph Merry Hat Co.



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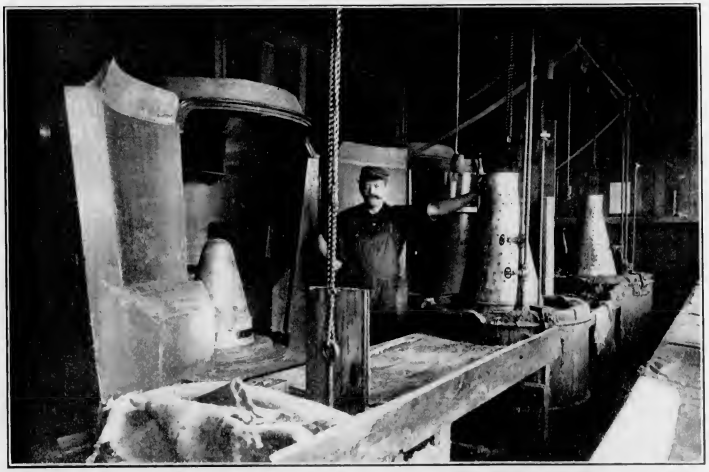

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Ridgway Co. Courtesy of Joseph Mercy Hat Co.

recovery-bins, in the formation of the fur body.) Larger glass windows in the doors (those prevalent are quite inadequate) might be a partial solution of this difficulty which is serious enough to merit attention. Sometimes there is lack of co-ordination of movement between the "feeder" and "coner," so that the former may release the apron and start the feeding a moment too soon. Commonly, however, signals by bell or otherwise are unnecessary; the "coner" working with a rhythmic swing from the machine to the self-sinker and back, and the "feeder" adapting herself to his motions which become almost automatic.

When all the fur has been deposited in a thin layer about the copper form, the "coner" opens the door (usually liberating a final flurry of fur); deftly wraps the now drab cone with two pieces of burlap saturated with very hot water from the vat beside him; slips over the burlap a perforated metal outer cover; and lifting the whole from inside the balloon places it on the wooden rack of a "self-sinker" which, as he throws the clutch that releases it, disappears with the future hat beneath the steaming surface of the vat. It is cause for regret that the sanitary practice of spraying the fur-body on the cone, while still inside the balloon, (in lieu of the self-sinker) is not generally considered feasible with a high grade mixture. The Massachusetts mill-room in which this is done is noticeably clean and free from dust. Another cause for trade-prejudice is the fact that the exhaust fur becomes wet, necessitating drying before it can be returned to the blowing-machine.

After a brief immersion the "self-sinker" is raised; the outer cone and burlap removed; and the fragile and barely felted fur-body is peeled from the copper cone by means of inverting it, and allowing what now resembles a great fools' cap (some 28x30) of wet gray blotting paper, to slip off as it turns inside out by its own soggy weight.

HARDENING. To compact this body, and insure sufficient felting of the fur-fibres to permit starting the sizing (or shrinking) operations, a "hardener" working at a sloping bench near the forming machines inspects each body; holding it up to the light to detect thin places, which he reinforces (or "stops") with a wisp of loose fur; or picking out imperfections such as bits of dags which have somehow persisted in the mixture in spite of the blowing operation. This is trying work for the eyes (as well as conducive to mercury poisoning by skin absorption through the hands) even when done in front of an outer window; and the use of artificial light is to be deprecated from an economic point of view. Where the latter cannot be avoided, a frame of ground glass, suspended before the electric spot-light, will be found of service in diffusing the glare and making satisfactory inspection possible.

After examining from eight to twelve fur bodies (according to the quality handled) the "hardener" opens them out; lays them flat in

order; and sprinkles the pile with hot water by means of a brush. Then wrapping them in a flannel cloth, he proceeds very gently and deftly to start by hand-manipulation the actual felting process, which, after some ten minutes' rolling and kneading, prepares the bodies for the "starter."

While there is hazard in the forming-room from high speed belts and wheels which require safeguarding, excessive heat and humidity are the cause of almost universal annoyance and suffering to the workers. The trade sanctions the foreman's uncontrolled use of steam from the self-sinkers, or live steam devices, to obtain sufficient moisture in the air to insure good results in the forming machines; but no standard has been set, and thermometers may register 100° unquestioned. Occasionally a foreman keeps his windows open (because his first foreman did where he learned his trade) and maintains that the advocates of "no ventilation" merely lack the skill to handle their suction properly. (See Plate XV.) (See Appendix.)

A notable exception is found in the mill-room of the largest concern in Danbury. In this long, narrow room so many forming machines are placed, that the combined suction was at first sufficient to draw in the window sashes, and no one could open the doors by hand against the partial vacuum. To remedy this without creating disturbing drafts, boxes were built in each window; every box housing a radiator coil and a steam jet. The foreman is provided with a thermometer and a hygrometer; the temperature is kept at 80 to 85°, and the humidity at 65°. Designed for purely mechanical reasons, this installation keeps the air of the work room fresh in winter. Recent experiments in Newark and Philadelphia, however, have proved that ample humidity can be maintained at a temperature of 70°. While the humidity of 65°-70° may be necessary during the cold season, when the fur is full of electricity, it is rarely essential in summer; and the Department urges the use of a hygrometer, or of a wet and dry bulb thermometer, in the mill-room, so that, for the protection of the workers, excess heat and humidity may be avoided. (See Appendix.)

Here, as in the blowing-room, the simple device of substituting a coarse muslin cloth for the glass panes of one or two windows, is an effective aid to draftless ventilation.

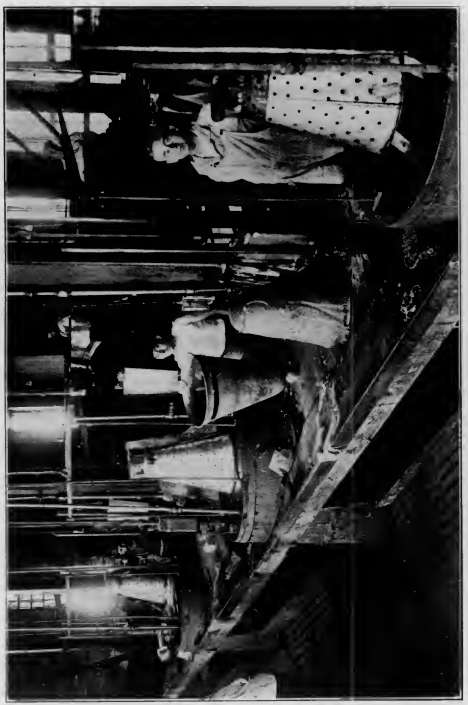


PLATE XV.
A Well-Ventilated Mill Room (14 ft. Ceiling). Free from Excessive Heat and Humidity.
Courtesy of E. V. Connett & Co.

THE WET PROCESSES.

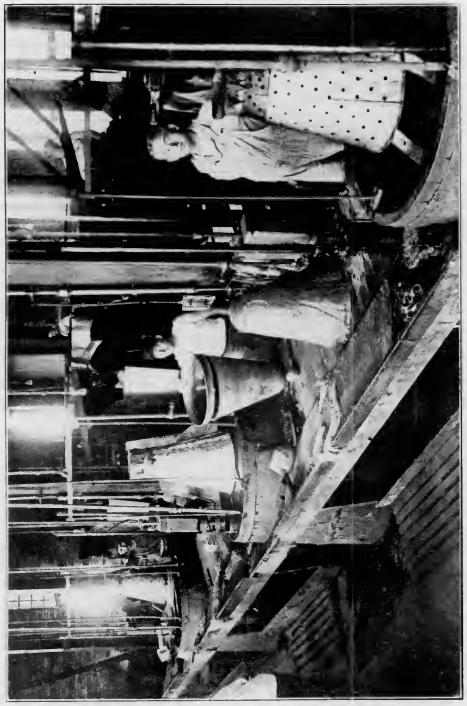
THE STEAM HAZARD.

HAND STARTING (OR WETTING-DOWN). From the "hardener" the fur-bodies may go to the Weighing-out and Passing room, or be given direct to the "starter." (So long as the bodies are kept wet, they may stand several days without disadvantage; provided weather conditions are such that there is no danger of the fur-fibre taking hurt or "souring.")

The hand starters still work about an open vat or kettle, surrounded by sloping planks forming an eight-sided "battery", exactly like those in use two centuries ago; excepting that steam has recently replaced the fires under the kettles, and thus simplified the task of keeping the water at the boiling point. This water is frequently acidulated with a low percentage of oil of vitriol, when the fur mixture is one which does not felt readily.

The "starter" begins the real work of shrinking the fragile fur-body from a dunce cap over two feet in diameter, to the comparatively small dimensions of a man's derby or soft hat. Rolling four of the bodies in a piece of burlap, and at first sprinkling them with a brush dipped in the boiling water of the battery by which he stands, he works and kneads and rolls them inside the burlap until the felting process is well under way. The fragile bodies grow firmer with each passing second; and after frequent dippings into the hot water, and a careful shifting of the position of the bodies so that tip and brim and sides shall felt evenly, at the end of twenty or thirty minutes they have shrunk to firm-textured cones, averaging some twenty by twenty-two inches. The very finest grades of hats are always thus started by hand; the "starter" averaging from eight to twelve an hour, according to whether he handles heavier or lighter weight bodies. The same eye-strain noted in the case of the hardener is experienced by the starter, for he also must continually open and search the body for defects; occasionally turning it inside out so that the undersides shall not felt together (especially on the creases) thus producing a streak known to the trade as a "lightning-rod."

MACHINE STARTING. The same result can be obtained by the use of machinery, provided a somewhat coarser quality of fur is being handled. In that event eight or twelve bodies, folded in burlap and dripping from the boiling kettle, are run through the three revolving wooden rolls of a starting machine; whose "lags" (pegged or "dowelled" at two inch intervals the length of the rolls) press in alternation as the rolls revolve in opposite directions, until, (aided by



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MACHINE SIZING. This is the most laborious operation of the felting process. Instead of standing around a battery and working by hand, as was formerly the practice, the sizer works at an individual steam-boiled kettle above which are three power driven wooden rolls, whose 5-inch "lags" are "dowelled" on in alternate block effect. (See Plate XVI.) In these, two sets of fur bodies containing four hats each, (which have come from the hand or machine starter) are continually revolving; each set being wrapped in a burlap cloth, and removed alternately for dipping, and folding, and inspection. After some thirty minutes' work, the starter's final dimension of 20x22 has been reduced to hard, fuzzy gray cones about 10x15¼ inches, or whatever size is required to cover the block for which they are destined.

During the processes of hardening, starting, and sizing, the stronger fur-fibres have been gradually drawn together, forcing those of finer, softer quality to the surface, where they form a sort of coating for the tough underfelt of the bodies. So tenaciously does the intricately matted fur cling together, that it is almost impossible to pull a high-grade body to pieces; and only a knife can cut apart the interlocking scales of the thousands of infinitesimal fibres which, from now on, have lost their individuality in what is accurately designated as "felt."

SECOND SIZING. While not always essential to the shrinkage of the future hat, second sizing (which takes place after the stiffening process for soft hats) is necessary on fine grades to tighten the felt, and insure uniformity of dimension. It is now rarely done by hand; the spiral wooden rolls of the second-sizing machine, combined with the boiling water of its kettle, shrinking each lot of eight hat bodies the half or quarter inch needed to bring them down to the required standard dimensions.

BRIM STIFFENING. From the sizer the hat-bodies go to the foreman in the Passing Room for inspection; from thence to the drying room,* where they commonly hang over night; and are then taken to the stock room, where the various sizes of flattened rough gray cones are stacked up in lots, awaiting further processes of the Back-shop, which shall eventually prepare them for the finisher's hand.

From the stock-room the soft felts† go to the stiffener, who first dips them with a circular motion (that wets only the brim) into a solution of shellac; then runs them between rollers to force the stiffening into the body, and to press out the excess shellac. After this, before going to the dye-room, the second sizer (already referred to)

* See Drying Room. † See Stiff Hatting.

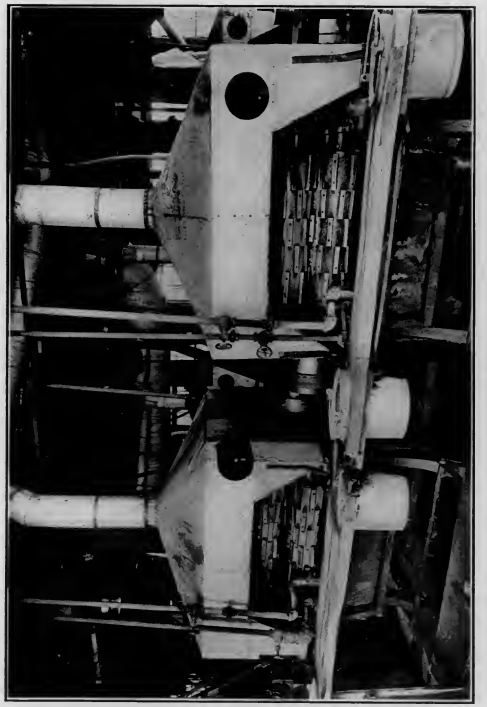

PLATE XVI.
Individual Sizing Machines, with Three "Lagged" Rolls, Revolving above a Steam-Boiled Kettle.
(Mechanical Exhaust Hoods.)
Courtesy of No Name Hat Mfg. Co.

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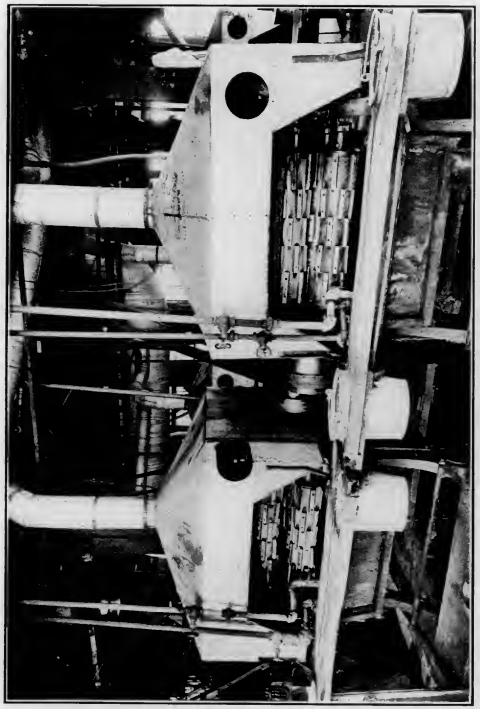

PLATE XVI.
Individual Sizing Machines, with Three "Lagged" Rolls, Revolving above a Steam-Boiled Kettle.
(Mechanical Exhaust Hoods.)
Courtesy of No. Stone Hat Mfg. Co.

tightens the felt; correcting any variations in the dimensions of the bodies, that may be due to lack of uniform measuring-standards among the various sizers employed in the Plank shop.

DYEING. While many soft hats are finished in the natural colors of the various mixtures, the majority go to the dye-room from the second sizer. The introduction of aniline dyes has revolutionized what was formerly one of the most secret processes of the trade; and has also lessened the health-hazards which are now practically confined to steam and excessive heat risks (once common in all sections of the Plank shop), and occasionally late-hour work. The bodies are thrown into steam-boiled dye-vats, (each color usually being run in an especial vat); and after several hours (ordinarily 3 to 4), during which they are continually stirred with a cross-barred wooden pole, the color penetrates and "sets" throughout the felt, and the brown or blue or black body is ready for the stretcher and blocker. (See Plate XVII.) In certain fine grades of hats where mixed effects are desired, or especial tints difficult to obtain after sizing, the cut-fur is dyed before blowing, and passes through forming, sizing and blocking without any further color treatment. The mixture is taken from the 5-pound bags in which it reaches the factory, and commonly placed between the two perforated metal sheets of a press in one of two tanks connecting with a centrifugal pump; and the dye is kept circulating from tank to tank (passing through the perforations of the press) until the fur-fibres are thoroughly impregnated. After being freed from excess moisture, the dyed mixture is carried to the drying-room, spread on wire racks, and slowly dried (with frequent turning); until after 24 to 48 hours' treatment it is ready for the mixer".

BLOCKING. While still wet from the dye-kettle, the hat-body reaches the tip stretching-machine. This is an ingenious device with parts that open out like so many metal fingers, and spread the conical tip into the semblance of a hat-crown. Next the brim is pulled out horizontally, and shaped by the metal thumbs and fingers of the brim-stretcher (which operation is frequently made easier by "rounding" the raw edge of the brim by machinery or by hand). Then the body is ready for blocking on an adjustable machine, from which it comes with approximately final dimensions; and with the felt (which has thus far been kept as hot as possible), at last thoroughly "set" by a liberal deluging of cold water. After being thrown into a centrifugal dryer to drive off the excess moisture, the "hat" (as it has at last become) is again ready for the drying-room; and leaving behind it the Plank-shop's almost universal hazards of steam and excessive heat, it once more encounters that of dust, but of a character even more dangerous to the worker than any previously met with in blowing or mill-room.

SANITATION OF THE BACK SHOP. To those outside the trade, no adequate conception of the discomforts of the typical Plank-shop

PLATE XVII.
A Dye Room with Mechanical Exhaust Hoods over all Steam-Boiled Vats.
Courtesy of No Name Hat Mfg. Co.

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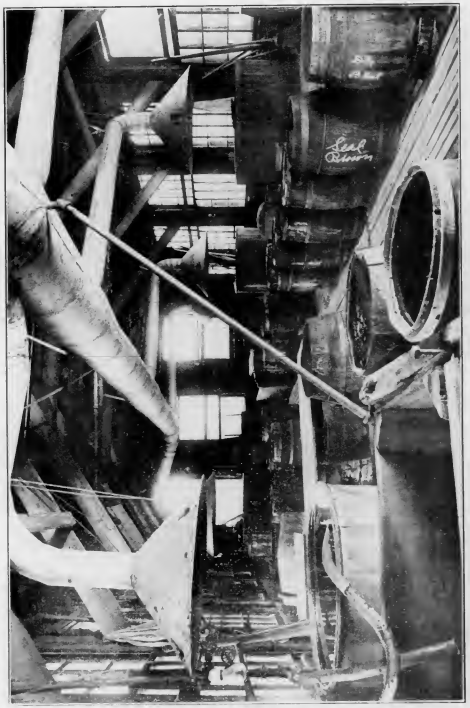


PLATE XVII.
A Dye Room with Mechanical Exhaust Hoods over all Steam-Boiled Vats.
Courtesy of No Name Hat Mfg. Co.

can be conveyed by the mere statement that—from starting to blocking—the makers work over kettles of water kept at the boiling point. For the greater part of the year (excepting when warm weather and open windows lift the blanket of steam from this department) the average sizing and dye rooms are filled with an impenetrable fog. The starters at the octagonal battery, (their shoulders almost touching), may each one be conscious of his speeding mates, but can only identify them by sense of touch. The machine-sizers only hear the clatter of their revolving "lagged" rolls; and divine the aisle guarded by a vibrating line of invisible and, therefore, dangerous power-driven belts. In cold and damp weather, in dye-room or plank-shop, there is no escape for the worker from the hot, podgum-scented fog; through which the strongest electric spot-light shows blurred and ineffectual. In addition, all kettles are drained twice a day, but without direct sewer connections; the hot water flowing through open drains in the cement floors of the best shops, or spreading out over the whole department in the majority of cases. The same traditional practice also obtains in the dye-room. Moreover, the brim and tip-stretching and blocking machines are continually slopping-over; condensed steam drips from ceiling and rafters; while each starter and sizer contributes his quota of sousing and splashing, to a resulting unparalleled total of handicaps to health and industrial efficiency.

There are few familiar with earlier winter trade-conditions at their worst, who cannot recall seeing highly skilled American workers standing with chilblained feet in water but little above the freezing point; dripping with steam and sweat from the waist upward; their hands raw from the friction of their plank-pins and wooden or leather shields (called "gloves"); an old umbrella hung overhead to keep off the trickling condensation from the roof; uncomplainingly paying their physical toll of colds, coughs, bronchitis, pneumonia, consumption and mercury "shakes," to the so-called "necessary hazards" sanctioned by centuries of hat-making.

On the other hand, there is none familiar with certain of our largest factories, (whose model concrete-floor construction, free outside ventilation, ample light, and location of the sizing department in the upper story would seem to possess all the obvious advantages due to modern sanitary standards) who does not know that when natural-draft hoods alone are relied on for steam removal, the results are distinctly unsatisfactory. Even in such shops, for at least five months of normal winter weather, the workers must rely on sense of touch rather than vision in the operations of starting and sizing. Tests have shown that the humidity in the vicinity of the worker approaches the saturation point; and although health-risks are lessened by other sanitary provisions, at all seasons they are subjected to the almost daily discomfort of steam and excessive heat.

Serious as are the physical effects of such habitual exposure to

heat and humidity during working hours, there are also allied risks incidental to the ordinary Back-shop practices which for generations have been ignored alike by employer and employee. While lack of proper washing facilities and the prevalence of unsanitary toilets (including those in detached buildings that involve chilling exposure of workers to inclement weather) are a health-menace, the absence of airy, well-heated dressing rooms (where street clothing may be kept during the day, and wet working clothing be changed and hung to dry over night) is largely responsible for the Back-shop's sickness and death record from respiratory diseases.

It is true that blowing-room and forming-room give the most harrowing instances of "shakes," partial paralysis and suicidal melancholia among mixers, feeders, foremen, coners and hardeners; the inhalation of nitrate of mercury dust being in these cases direct; while coners and hardeners have the added exposure of absorption of the poison through the skin of hands and forearms. But scientific physical examinations of starters and sizers fail to substantiate the traditional claim of the Plank-shop that this department is practically free from mercury risks. The chronic effects are merely of much slower manifestation. The many instances quoted of men from the mill-room who have been transferred to the Plank-shop to "sweat out" their incapacity from "shakes," while undoubtedly authentic, indicate not complete recovery, but a beneficial change of symptoms. Their experience cannot be accepted as proof of the actual healthfulness of this department, or of their subsequent freedom from the subtle poison in question; which still circulates though with lessened violence as an albuminate through their system, and (as in the case of many of the older starters and first-sizers) may often be detected in the saliva, urine and other secretions.

Health questions aside, excessive steam has its serious economic disadvantages for the employer. The fact that for six months of the year such delicate operations as starting and second-sizing must be carried on practically by sense of touch, has led progressive hat manufacturers to question the necessity for conditions which almost inevitably lower the grade of output, and increase imperfect furbodies or "knock-downs."

The history of twenty years' effort to control the generally deprecated steam-hazard is, however, almost universally a history of disappointment and of practical failure. The initial difficulty to combat was the fact that in old style buildings the Plank-shop was built on, or even in some cases below, the ground level; and overhead factory construction prevented the obviously beneficial device of direct ventilation through the roof. The first more or less elaborate metal hood-installation over the kettles (improved examples of which may still be found in some of our largest factories) being wholly dependent on natural draft, not only failed to remove the steam under all weather conditions, but, being improperly galvanized and jointed, were soon eaten out by fumes and fell into disrepair.

The gradual increase of mechanical exhaust ventilation in industrial processes—while offering hope to the Plank-shop—did not bring an easy solution of what experts soon recognized was a problem of almost unparalleled obstinacy.

THE WARM AIR SYSTEM. One of the first costly failures of the Danbury district was based on the scientifically correct principle, that raising the temperature of the atmosphere enormously increases its moisture-carrying capacity. Introducing dry warm air into a moisture-laden room will absorb the steam particles in much the same manner that a sponge absorbs water; and if permitted to pass out, will carry the moisture with it. (At 70° Fahrenheit one cubic foot of saturated air contains 8 grains of moisture. At 155°, one cubic foot of air is capable of carrying 80 grains of moisture,) Without rise of temperature on a winter's day, when the thermometer stands at 30° or 40° or lower, the fog in the unventilated sizing-room condenses and settles, and open windows only increase the discomfort of the workers. It was experimentally found that if a current of air were directed over the steam coils of a heating system, so as to raise it from zero to 75° or 80° before injecting it into the sizing-room, it would be capable of absorbing and carrying off steam, provided it were pumped in so as to give a complete air change every three to four minutes. (Subsequent experience suggests one and one-half to two minutes). Scientifically this theory is still unquestioned; but practical experience has shown that old type factory construction, and the "human factor," render its successful operation almost impossible. The whole balance of systematic warm-air steam-removal depends upon the maintenance of purely mechanical means of air-exchange; of which closed windows and tight walls are the first necessity. The early direct-radiation method, in which the relation between pulling and introducing air was not properly adjusted, did little more than warm up the rooms to such a temperature that rain (from roof condensation) was substituted for fog, and the men refused to work. An attempt to introduce mechanical balance between the air supply and exhaust system (which was dependent on personal supervision), was hardly more successful. It is obvious that if the hot-air supply is adjusted to raise the temperature from 30° to 65°, a bright warm day at 40°, or more, will give an uncomfortable excess of heat in the work-room, unless there be a readjustment of the intake-heaters. Only unattainable vigilance on the part of the foreman could hope to keep pace with the changes of the American climate. The result in this instance was that the temperature of the sizing-room would go up till the men were forced to open the windows, thereby destroying the balance of the whole system. A different, but no less disastrous, effect occurred when the sizers adopted the practice of drying piles of fur-bodies in front of the hot-air intakes, and thus blocking their free operation. When the windows were nailed down by the management to ensure protection to the system, they were smashed; and "shop calls" issued to protest

against what the operatives condemned as merely an added discomfort. As an outcome of this experience a warm-air system now operating in the Danbury district is provided with *automatic control by a thermostat*, so that the heat is shut off as the outside temperature rises; keeping the incoming air-current at a uniform 65 to 70 degrees, with a three-minute air change. It has been found that intakes should discharge 2/3 of their volume near the floor and 1/3 near the ceiling; exit vents should be near the floor, but high enough to avoid danger of becoming accidentally blocked by piles of hats. This does away with the necessity of ordinary heating in the winter; and it has the advantage of being convertible in hot weather into a cooling system, by simply drawing the incoming current over cold water instead of over steam coils. As a further precaution to make this system respond immediately to any weather fluctuations, it can be provided with a variable speed-drive, so that the rate of air-change may be increased on particularly humid days. Elaborately calculated as is this system, accidental or intentional introduction of free outside air throws it out of balance within a few minutes. (See Plate XVIII.)

Another of the Back-shops, (in Bethel), which has achieved a reputation for steam-control, accomplishes it by having, in addition to an air-conditioning system, a double ceiling, with an air space between, that in winter prevents condensation from chill when the roof is piled with snow.

A method of limited usefulness, frequently disappointing in cold, damp weather, although possessing advantages over natural draft installations, is that of a wooden duct exhaust-system run between a double row of sizing-machines placed back to back. This cypress-trunk line is connected to each machine by intakes 2½ inches in size one way, by the width of the tub itself the other; the fan so proportioned as to handle the volume of steam-laden air which would pass through an area equivalent to the total area of the sizing-machine connections, assuming a velocity of air through these openings of not less than 1,000 feet per minute. As this installation, however, is not possible on scattered machines, or on starting and hand-sizing batteries, its usefulness is necessarily limited.

In discussing all these systems it must be borne in mind that not only continual steam from the Plank-shop and dye kettles must be handled, but that twice daily these are "pulled" after the primitive fashion in vogue before sewers were dreamed of; and that then such volumes of all but boiling water sweep over the floors, or through open drains, that this excess steam will temporarily overtax and throw out of balance any warm air system however elaborately designed.

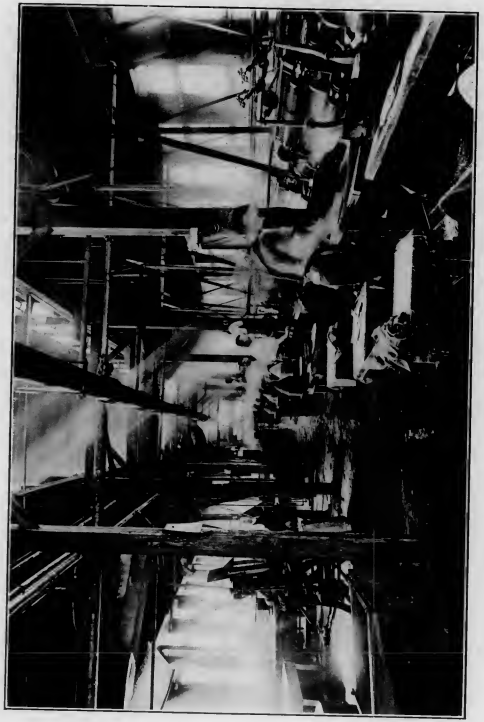


PLATE XVIII.
Warm Air System of Steam Removal.

Courtesy of Mallory Hat Co.

STANDARDS OF THE NEW JERSEY DEPARTMENT OF LABOR.

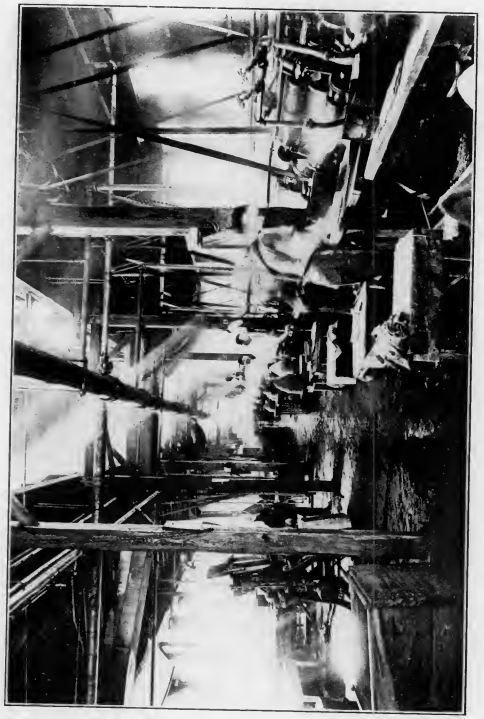
After months of investigation, experimentation and discussion with ventilating experts, the Department decided upon the direct method of steam-control at the point of origin, rather than the adoption of the warm-air system of steam removal. The accompanying illustrations make clear the manner in which the desired end has been achieved. With this system also (as in the case of warm air steam-removal) provisions should be made for a properly balanced supply of fresh air, so as not to create a partial vacuum against which the exhaust-fan must work. While there is still a difference among experts as to the best location for these intakes, experience has shown that at least 75% of the supply should be provided near the floor (at points free from blocking); and so figured that the incoming air passes with a lineal velocity of 250 to 300 feet per minute, through steam pipe-coils fitted to raise the temperature where necessary from zero to 65° to 70°. This is not only essential for satisfactory steam removal, but is also a convenient and easily arranged method for heating in winter.

A higher velocity than 250 to 300 feet per minute is not practicable; it would create a strong resistance for the fan to overcome, necessitating a higher speed with consequent loss of power, which runs up with the cube of the speed: a lower velocity, excepting with an elaborate distributing system, would mean impracticably large openings. A register should be provided for the intakes, so that they may be closed and prevent cold air from coming in when the plant is shut down.

Briefly stated, the New Jersey system of steam-removal is based on the idea that the place to control steam is at the point where it is generated; that it should be confined at that point, and drawn off before it has a chance to circulate in the air of the work-room. Practical experience has proved this method to be completely successful; and the resulting clear atmosphere in the dye room and plank shop has such distinct business advantages, that it is doubtful if any manufacturer, (who for the first time in the winter history of the local hatting-industry, sees hats sized in a perfectly clear room), would go back to the old days, when starters worked for months, largely by sense of touch; and when sizers were unable to see one another at a distance of thirty inches. (See Plate XIX.)

The detailed specifications covering the Department's standard steam-control system are as follows:

All hoods shall be constructed of No. 18 gauge galvanized sheet steel or Toncon metal. Hoods shall completely cover the sizing machines, with the exception of the front, as indicated on the detailed blue print; cover sides, gearing, and extend down to a point flush



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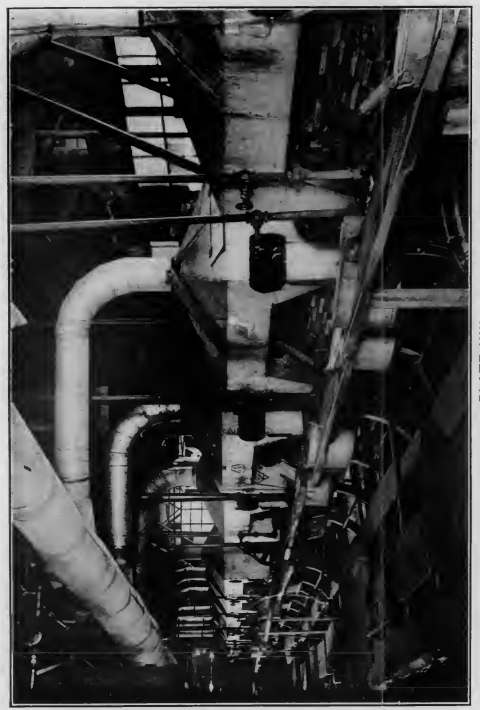


PLATE XIX.
A Battery of Sizing Machines in Old Type Factory, with Mechanical Exhaust Hoods Removing all Steam at Point of Origin.
Courtesy of No Name Hat Mfg. Co.

with the top of the hot water tank. All edges to be wired. (See Plate XX.)

Diameter of pipes leading from dye kettles.

Where diameter of kettle is from 24″ to 30″ branch shall be 5″ in dia.
Where diameter of kettle is from 30″ to 40″ branch shall be 6″ in dia.
Where diameter of kettle is from 40″ to 48″ branch shall be 8″ in dia.
Where diameter of kettle is from 48″ to 60″ branch shall be 10″ in dia.
Where diameter of kettle is from 60″ to 72″ branch shall be 12″ in dia.
Blocking kettles with square tanks 24″x24″ branch shall be 6″ in dia.
Blocking kettles with square tanks 24″x36″ branch shall be 7″ in dia.
Blocking kettles with circular tanks 20″ branch shall be 5″ in dia.
Starting machines with tank.....30″x12″ branch shall be 7″ in dia.
Double sizing rolls with tank.....36″x38″ branch shall be 8″ in dia.
Single sizing rolls with tank.....24″x36″ branch shall be 6″ in dia.

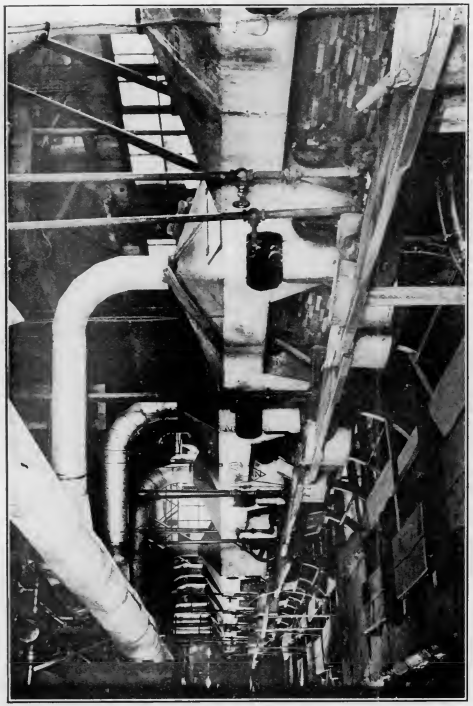
The inlet and the outlet of the exhaust fan shall have an area equal to the combined area of all the branch connections on the system.

The exhaust fan shall turn at a speed sufficient to raise 1″ of water in a U-shaped tube; test to be made by punching a small hole in the branch pipe at a point within 15″ of the hood; test to be made with the entire line open.

The Main Duct shall at all cross sectional points have an area equal to the combined areas of all branch connections at that point. (See Plate XXI.)

The gauge of metal to be used in the Main Duct and branches to be stated in plans submitted to the Department of Labor for approval before the installation is made, and to be determined by the size of the pipes.

All of the New Jersey felt hat factories (excepting a few, on which orders have been served to make installations) have already been equipped with the above type of steam-control. The system works perfectly; and by frequently changing the air in the work-room not only removes excess moisture, but has peculiar advantages in the summer as well as in winter time. In the latter season it keeps the room clear of steam and excessive heat; in summer it affords excellent ventilation, and prevents incidental conditions of excessive humidity wherever steaming hat bodies are piled, and also where the kettles are pulled. A series of tests has proved that in warm weather the temperature of the old type sizing room is from 15°-20° above that of outdoors; while the humidity in the vicinity of the worker approaches the saturation point. Where standard exhaust steam-removal has been installed, the temperature of the room is practically that of outdoors, and the humidity is only 4°-6° above that of the atmosphere. Moreover the constant air-change so adds to the comfort of the worker, that there has been a marked improvement in the physical condition of Plank-shop employes, and in the uniformity their output. (See Plates XXII. and XXIII.)



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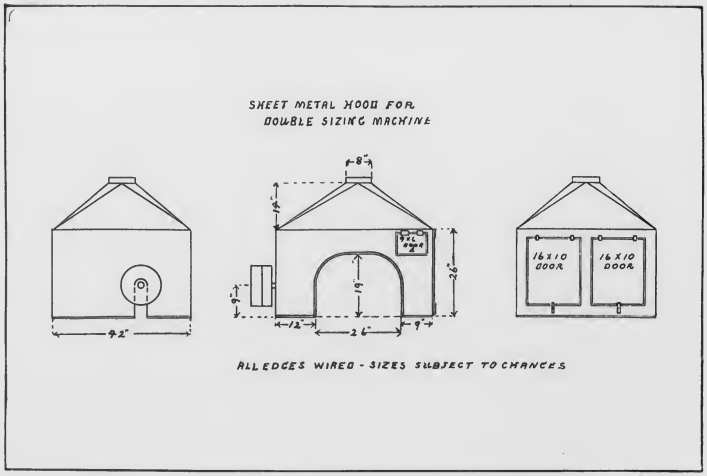


PLATE XX.
Detailed Specifications for Sheet Metal Hood for Double Sizing Machine.

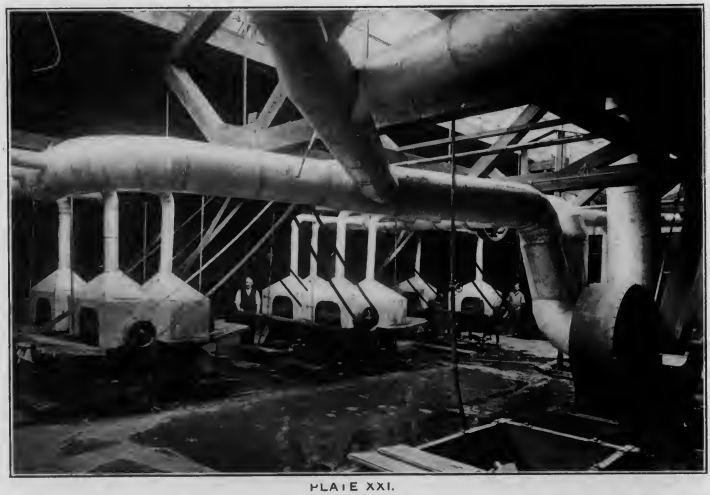
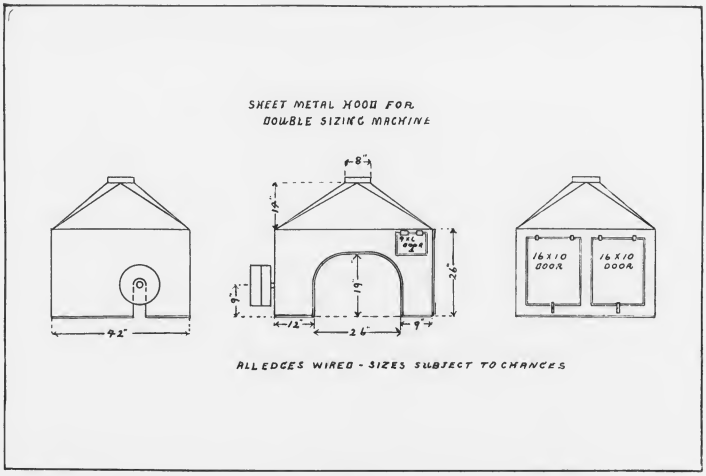


PLATE XXI.
Typical Standard Mechanical Exhaust Installation for Steam Removal, Showing Main Trunk Lines and Fan.
Courtesy of Max Metz Co.



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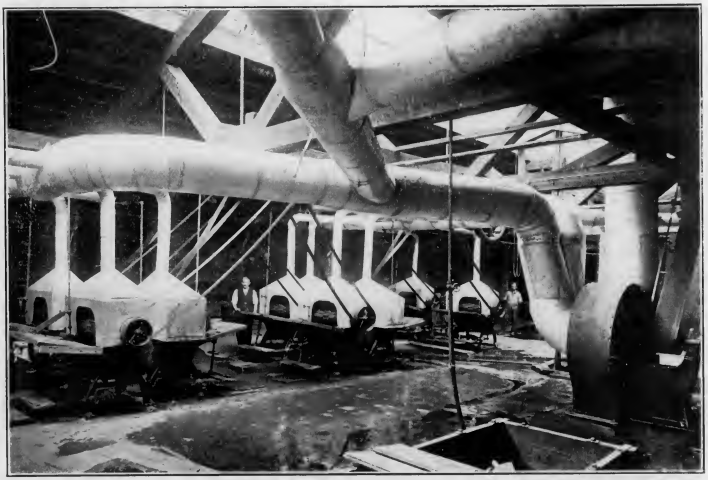

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Courtesy of Max Metz Co.

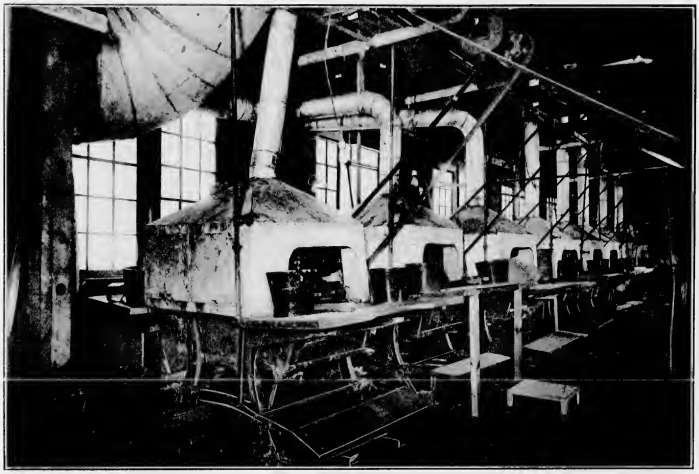


PLATE XXII.

A Battery of Sizing Machines, with Mechanical Exhaust Hoods in Old Type Room, now free from Steam and Excessive Heat. Courtesy of E. V. Connett & Co.

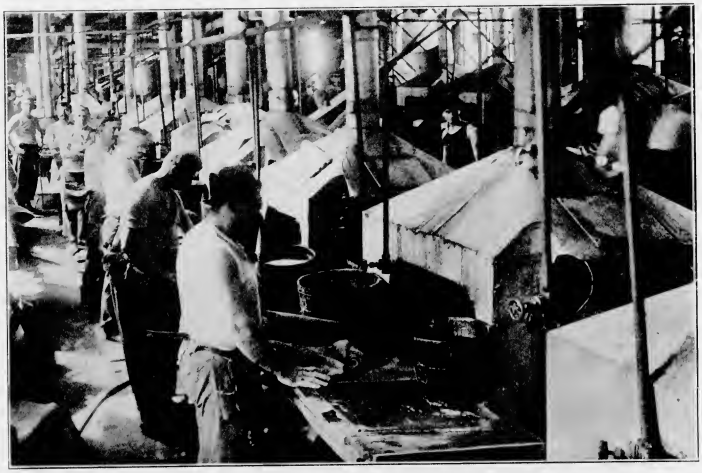
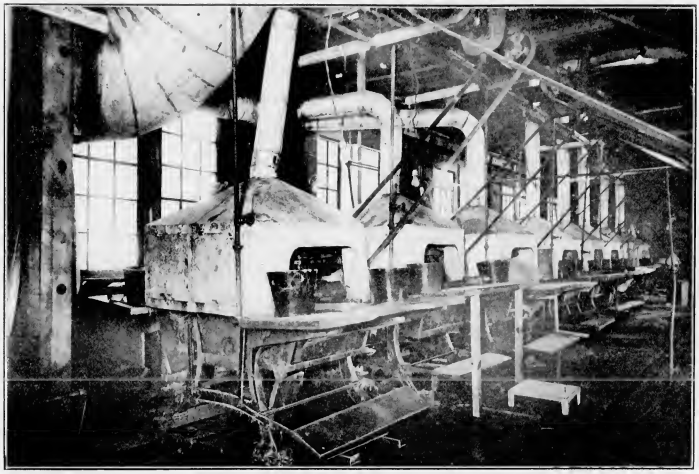


PLATE XXIII.

Standard Installation in Sizing Room where Relative Humidity Does Not Now Exceed by 5° that of Outdoor Air.
Courtesy of E. V. Connett & Co



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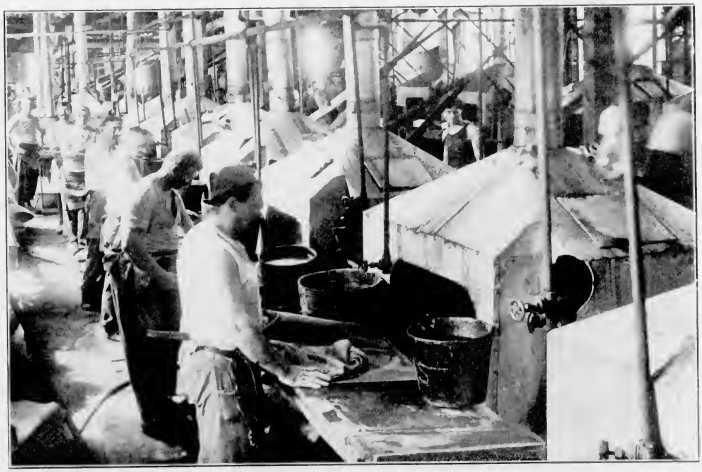

PLATE XXIII.

Standard Installation in Sizing Room where Relative Humidity Does Not Now Exceed by 5 that of Outdoor Air.

Courtesy of E. V. Connett & Co

DRAINAGE. The universal practice (already noted) of running the waste water from sizing kettles and dye vats over the floor through an open drain, is not approved by the Department. It is one of the customs that is a heritage of the past, and which modern shop-methods condemn. There is no reason in this day of sewage sanitation why, in laying out a hat factory, closed drains cannot lead from each kettle and tub directly to central traps and thence to the sewage system. As a matter of fact, in several shops closed drains have been provided; and in connection with steam-control this improvement contributes to a general condition of cleanliness and dryness that would amaze the old type of hat manufacturer. With reasonable care all "podgum" (loose hair and fur which works through the felt, collects in the kettle, and is dried and returned to the blowing machines) can be skimmed from the surface of the kettle as soon as the water stops boiling; or be collected in perforated copper devices and so prevented from blocking the drains. (See Plate XXIV.)

Under the present plank-shop conditions, and until all waste water is properly run into the sewer through tight pipes (in which there may be convenient clean-outs), substantial wooden gratings to stand on should be provided by the employer, so that the workers' feet may be kept out of the slops and running water.

PLATE XXIV.
An Old-Type Sizing-Room, Made Sanitary by Mechanical Exhaust Ventilation over Kettles, and by Direct Drainage to Sewer.
Courtesy of No Name Hat Mfg. Co.

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(Courtesy of No Name Hat Mfg. Co.)

DUST HAZARD.

POUNCING. In spite of plucking and blowing, some hair-fibres persist in the fur-mixture. During the sizing operations these work through the felt and protrude from the surface; giving a shaggy appearance to the blocked hat, and necessitating special treatment for their removal.

The pouncing-room where this is accomplished is neutral territory; being claimed according to local custom by either Back-shop or Front-shop. The process of pouncing is simple, consisting merely of placing the hat on a rapidly revolving felt-covered wooden block (turned by machinery), and rubbing the crown smooth by the friction of a piece of fine emery paper, pressed against it by the "pouncer." The brim is then smoothed (first on one side and then on the other) by the emery-covered rolls of a brim-pouncing machine; or it may be pounced simultaneously on both sides by an ingenious device known as the "jigger."

During these operations, especially that of crown-pouncing, a cloud of fine dust (highly irritating to the throat and lungs of the worker) is thrown off. It is this fact which makes the pouncing department of such tragic interest to the trade itself; and also to communities unknowingly infected by the induced tuberculosis once all but inevitable among "pouncers." No records of industrial consumption are more harrowing, or more authentic, than those of such victims furnished by physicians' and hospitals' data collected in Connecticut, New Jersey, New York and Pennsylvania.

A tardy recognition of this fact (as well as interest in good-housekeeping and the fire risks involved in the dusty condition of the pouncing-room) has induced modern employers to install various devices for controlling the powdered hair-fibres. Until recently, however, few of these were other than unsatisfactory. Even where fan-power was not unwisely economized, the type of hood of the exhaust-installation was such that the workers continued to breathe a dangerous quantity of dust; and still left their benches at noon and at night hardly recognizable because of the pounced hair and fur which covered them.

STANDARDS OF THE NEW JERSEY DEPARTMENT OF LABOR.

Being convinced by experiment that the centrifugal force with which the pouncing-dust is thrown off cannot be overcome with a 2" pull, except by means of an enclosure around the spinning hat-block,

the Department sought for a type that (while not interfering with the operation itself) would sufficiently confine it, to insure its removal by means of the attached exhaust ventilation. The accompanying illustrations, and detailed specifications, explain how the pouncing-rooms of the State have been absolutely freed from dust, and consequently from all menace to the health of those employed therein. (See Plate XXV.)

SPECIFICATIONS.

Pouncing on hat-blocks shall be done in a hood constructed in accordance with the detailed specifications shown in the cut.

For crown-pouncing the branch-pipe leading from the hood shall have a diameter of 5 inches.

For brim-pouncing the branch-pipe leading from the hood shall have a diameter of 4 inches.

The figures showing the width of the pan of the pouncing-hood are approximate. In case of extremely large hats, the figures may be increased to allow room for the hat to spin freely on its block. The given figures showing height of front and back, however, can be used in all cases to advantage. (See Plate XXVI.)

The inlet of the exhauster shall be at least 20% greater in area than the combined areas of the several branch connections to the hoods; and this increase shall be carried proportionately throughout the entire length of the main trunk-pipe. The piping on the outlet of the exhauster shall be at least 20% greater than the combined areas of the several connections to the hoods. Sufficient suction-head shall be maintained within 15 inches of the hoods to raise a column of water at least 2 inches in a U-shaped tube. Test to be made by pressing a tube attachment over a small opening in the pipe (commonly called the Static method). Test to be made with all branches open and unobstructed.

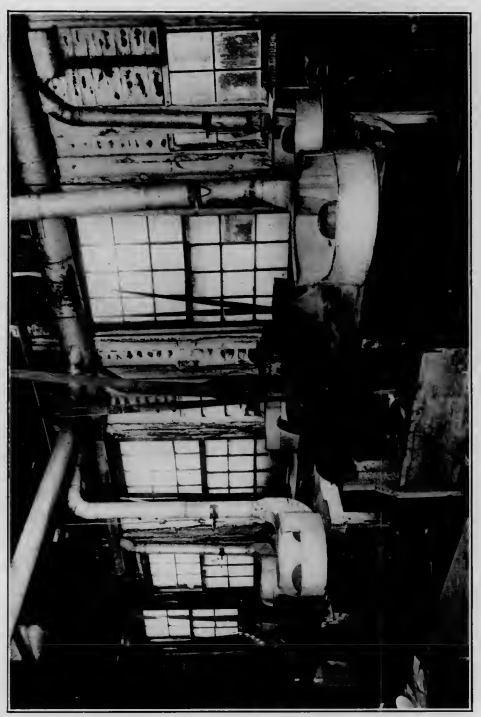


PLATE XXV.
A Dust-Free Pouncing Room, with Standard Mechanical Exhaust Installation.
Courtesy of E. V. Connett & Co.

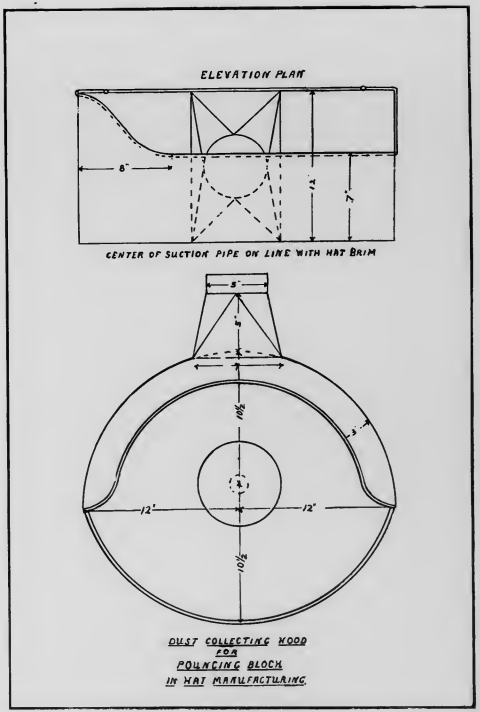
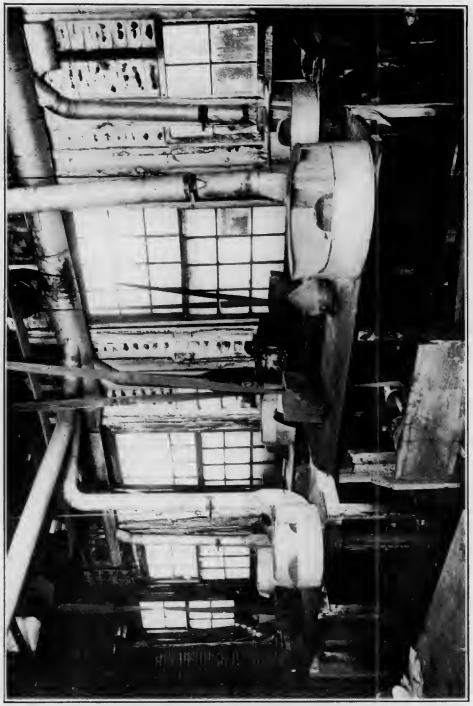


PLATE XXVI.
Specifications for Pan of Pouncing-Hood.



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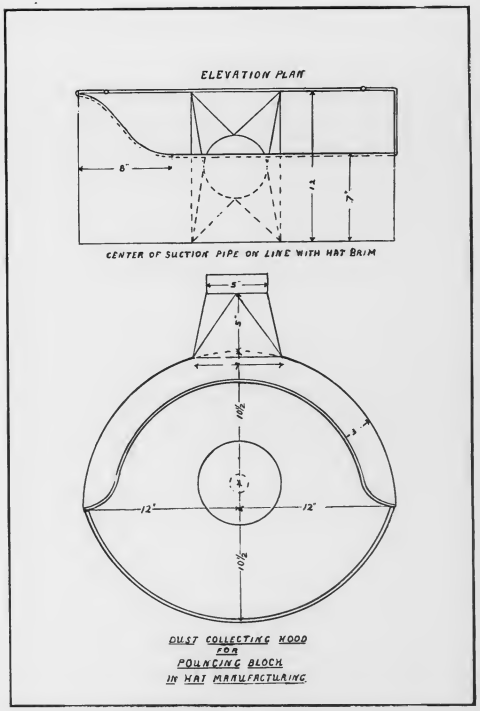

PLATE XXVI.
Specifications for Pan of Pouncing-Hood.

DRYING ROOMS.

From the sanitary and economic points of view, the drying of the hat-bodies offers some interesting problems to the trade. The old type—commonly dark lofts situated above the boiler-room, without any means of ventilation—were both wasteful of steam-heat, and slow of operation. Fitted with fixed pegs, the bodies could only be hung and stripped by entering the room itself; which was frequently in the neighborhood of 140°, and therefore subjected those so engaged to much unnecessary discomfort, and (in cold weather) to risk of chill.

Modern methods have condemned the old-type of dry-room, because of the fact that in such closed chambers the air soon becomes saturated with moisture; and (having no means of escape beyond incidental cracks) takes from twelve to fourteen hours to accomplish satisfactory results.

The Dryers shown herewith in a well-known plant in Danbury are as efficient from the point of steam-consumption and speed, as they are comfortable for the workman. (See Plate XXVII.) A series of chambers open from a large airy passage, whose outer wall is fitted with center-hung windows. In this hall are horizontal rods arranged so that the movable racks can be hung with bodies and hats out in the cool. Each drying chamber opening into this hall is fitted with horizontal pipes across its top; and from these the movable wooden racks are suspended after they are full. In the ceiling of each chamber there is a 10-inch opening, directly above each of two horizontal rotary fans about 4 feet in diameter; in the floor is a radiator-grate from which a pipe runs beneath the floor to an exhaust fan on the outside of the building. The pull on the lower exhaust is much less than the suction created by the ceiling fans; there results a mild current flowing through the chamber and out into the outer air, together with a heightened pressure within the chamber and a constant circulation about the inside. Steam coils run near the floor on both sides and maintain a temperature of 140° while the hats are drying; which operation can be accomplished in from two to three hours.

When a batch of hats are thoroughly dried, the steam is turned off in that particular chamber where they hang; the doors are thrown open; and the chamber allowed to cool. By a few revolutions of the fans with the doors open, this can be attained in a few minutes; so that the racks are stripped in entire comfort. The steam is not again turned on until the racks have been once more loaded, and the doors shut.

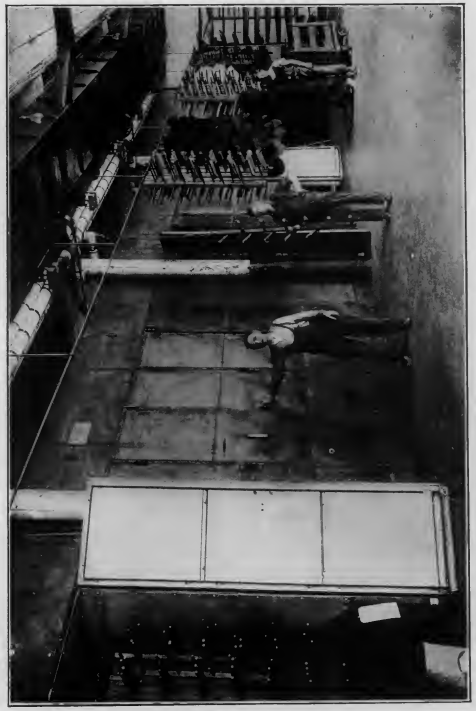

PLATE XXVII.
New Type of Drying-Room, Showing Movable Racks being Hung with Hats in Open Corridor.
Courtesy of Mallory Hat Co.

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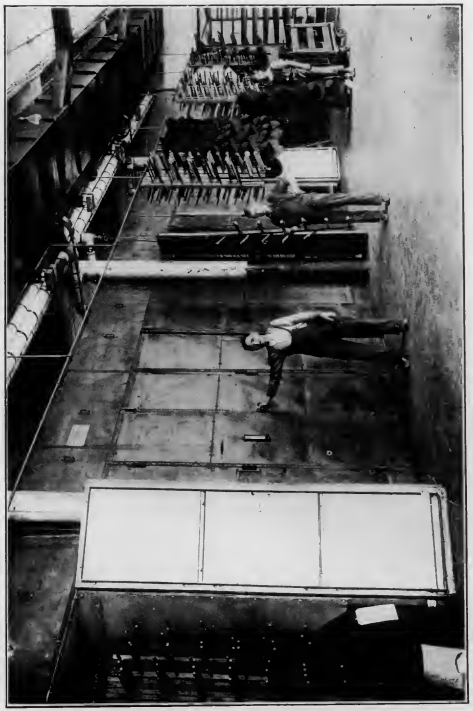

PLATE XXVII.
New Type of Drying-Room, Showing Movable Racks being Hung with Hats in Open Corridor.
Courtesy of Mallory Hat Co.

By working a series of such chambers in regular succession, two men can dry 250 dozen per day per chamber, utilizing merely the exhaust from the little engine that runs the fans. (See Plate XXVIII.)

Another satisfactory method is to place the hats in a movable rack-apparatus on wheels. This may stand in the open corridor, and be wheeled into and out of the drying-room without undue heat-exposure of the worker.

Where the new type of dry room cannot be easily attained because of factory construction, the adoption of movable metal or wooden racks (to be hung with hats outside of the chamber) should replace the fixed pegs so long sanctioned as a trade-necessity.

STIFF HATTING.

Until it leaves the hands of the sizer, the plank-shop treatment of the fur-body destined to become a derby is identical with that of the soft felt. From there on, however, certain differences must be noted, involving in two instances especial risk to the worker, and in one case, of fire-hazard to the employer.

SHAVING. As has already been commented upon, in spite of careful plucking and blowing, some hair remains mingled with the fur-fibres. During the sizing operations this works its way through to the surface of the body, giving it a coarse and rough appearance.

In the case of the soft hat this is subsequently gotten rid of by pouncing; but in stiff-hatting the body is dried and "shaved" immediately after sizing. Formerly this was always done by hand (which was a dangerous dust-hazard), the "shaver" laying the body over his knee, and dexterously passing a long razor-edged knife over the surface. At present the dried body is commonly shaved by being run through a machine, whose revolving knives operate after the principle of a lawn-mower. While the dust liberated during this mechanical shaving is of a less dangerous character than pouncing-dust, it is nevertheless a distinct menace to the lungs of the worker, and standard mechanical exhaust ventilation at the point of origin is essential. It should also be noted that safeguards are required on the shaving machines, as there are numerous instances on record of injury to fingers and hands of workers.

SECOND-SIZING. From the "shaver" the fur-body goes to the second-sizer who, either by hand or (more commonly) by machine, tightens the now open felt, and shrinks it the quarter or half inch necessary to bring it to the required dimensions.

STIFFENING. After the excess moisture is pinned out by hand or machine, the body is ready (after hanging in the dry-room) for stiffening by means of shellac dissolved in wood alcohol (called "wine-stiffening"); or by that which has been dissolved by the aid of an alkali (soda), called water-stiffening. The latter (used on cheaper

PLATE XXVIII.

Looking into New Type of Drying-Room, Showing Blades of Fan in Ceiling.

Ridgway Co. Courtesy of Mallory Hat Co.

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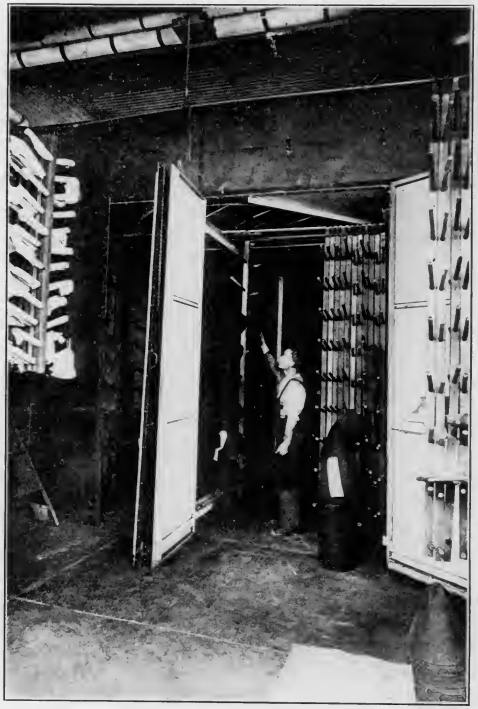

PLATE XXVIII.

Looking into New Type of Drying-Room, Showing Blades of Fan in Ceiling.

Ridgway Co. Courtesy of Mulberg Hat Co.

grades of hats) offers no health problems. The wine-shellac (owing to the highly poisonous and explosive character of wood alcohol fumes) constitutes a double menace to the worker, (who may experience headaches, eye trouble and mild "jags") and to the employer. Formerly wine-shellac was applied to one side of the crown, and to both sides of the stiffer brim, by means of a short stout brush about 3x5 inches; after which the shellac was driven through the fibres by rolling it on a marble slab, in the manner of second-sizing. The stiffening operation is now generally accomplished by means of machinery, that feeds the shellac through revolving rollers which turn the body and spread the stiffening. This, as in the case of hand-work, requires exhaust ventilation of the work-room to free it from the fumes liberated by the process.

DRYING. Formerly one of the most unsanitary features connected with the use of wine-stiffening, was the drying (with consequent evolution of fume) of the bodies in the open work-room. Health considerations and economy alike condemn this method; although the claim is still made that on the highest grade of derbies the slow method of evaporation in the open is an essential part of their wearing-qualities. Granting that such contention is valid, wherever the practice obtains, the drying should not be done in the vicinity of the worker; but in a room or rooms especially set apart, and mechanical exhaust ventilation is necessary to protect the health of those engaged in spreading and collecting the stiffened bodies. The best modern shops, with one or two exceptions, now have a drying-system for stiff hats which reclaims the alcohol fumes, condenses them, and not only saves 60% (after purification) of the alcohol for re-use, but also protects the worker by preventing the escape of poisonous fumes. In some factories both the cutting of the shellac and the drying are done in buildings entirely separate from the rest of the plant; the solution being piped underground to the stiffening departments. Sanitary considerations, and the ever-present risk of explosions, are thus satisfactorily met; so that if the latter should occur, the damage will be localized. The wisdom of this precaution is emphasized by some tragic experiences abroad and in this country.

STEAMING. After the solvent has been evaporated (or been neutralized in the case of water-stiffening) the stiffened bodies are nested, set upon pins in a box, the cover or doors closed, and the steam turned on. This liquefies the shellac, and the fur-fibres (by capillary attraction) draw it from the surface throughout the felt. The practice obtains in a few factories of placing the bodies (turned inside out) in the steam box for an hour; then turning them, sending them to the dry-room for several hours, and again steaming them a second time for not more than half an hour.

CLEARING. To complete the "clearing" and leave the surface in good condition for dyeing (which is not possible if the fibres be

coated or clogged) the bodies are dipped quickly into a hot alkaline solution (borax or soda), and then thrown into a bath of tepid water.

BLOCKING. After blocking (which process is the same as has already been described) the bodies are dyed, again blocked in final shape, and are then (after thorough drying) ready for the finisher.

(It should be noted that in stiff-hatting the dyeing does not always take place after stiffening. Practices differ in a few factories, and the bodies may be sent earlier to the dye-room, according to the grade of hats manufactured.)

THE FRONT SHOP.

HEAT AND DUST HAZARDS.

While practically every detail of felt-hat manufacture calls for skilled work, the processes in the finishing department for soft felts require a high degree of training. There are few fixed rules of procedure, for each finisher must adapt his methods to the color, weight and style of the hat he is handling; and the order in which he treats a pearl, brown or black felt varies from hour to hour.

After pouncing, before the hat is weighed out to the finisher, it may or may not have been "squared up" with gum Arabic water-stiffening and thoroughly dried.

STEAM BLOCKING. In the finishing-room it is first pulled over a wooden block of the exact shape desired for the crown; carried to a steam table in which are burlap-covered iron pots, through which live steam passes when a clutch is thrown; steamed by this means until the felt is soft enough to be pulled tight into place over the block by means of a semi-circular wooden tool known as a "puller-down"; and has a double loop of cord tied tight around the base of the crown to hold it in place, which essential detail is accomplished by means of a wooden wedge-shaped tool called the "runner-down."

To carry off the steam from the pots, natural draft ventilation is sufficient; provided the entire table be hooded so as to just clear the workers' heads, and there be direct connection to a stack or the outer air by means of a pipe not less than 12 inches in diameter.

CROWN IRONING. At this point, the hat is sometimes pounced by hand before ironing. Ordinarily, however, the blocked hat is at once placed for some five minutes or so on a crown (or tip) ironing machine, whose automatically guided "pressing-shells" were once universally heated by gas, but are now often kept at the requisite 400° by means of electricity. (See Plate XXIX.)

While a popular labor-saving device, nothing so contributes to vitiating the air of the finishing-rooms, as these long lines of gas-heated crown-ironing machines. Not only is the oxygen exhausted by combustion in these and the hand-shells, but it is rare to find installations entirely free from gas-leaks. In winter, especially in old-type factories with low ceilings, the resulting air conditions, combined with excessive heat, are highly injurious to the workers; the percentage of carbon dioxide being sufficient to poison the entire system. "When exposed to small quantities of this gas for a long period," writes Sir Thomas Oliver, "the vital resistance of the organ-

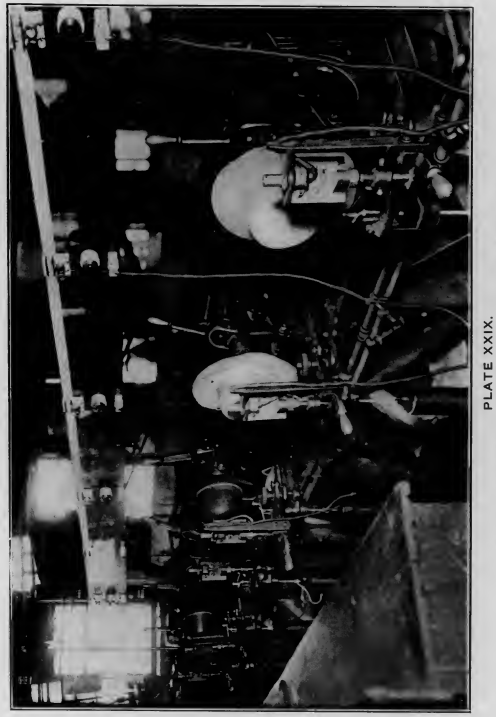

PLATE XXIX.
A Line of Electric-Heated Crown-Ironing Machines.
Courtesy of E. V. Connett & Co.

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CROWN IRONING. At this point, the hat is sometimes pounced by hand before ironing. Ordinarily, however, the blocked hat is at once placed for some five minutes or so on a crown (or tip) ironing machine, whose automatically guided "pressing-shells" were once universally heated by gas, but are now often kept at the requisite 400° by means of electricity. (See Plate XXIX.)

While a popular labor-saving device, nothing so contributes to vitiating the air of the finishing-rooms, as these long lines of gas-heated crown-ironing machines. Not only is the oxygen exhausted by combustion in these and the hand-shells, but it is rare to find installations entirely free from gas-leaks. In winter, especially in old-type factories with low ceilings, the resulting air conditions, combined with excessive heat, are highly injurious to the workers; the percentage of carbon dioxide being sufficient to poison the entire system. "When exposed to small quantities of this gas for a long period," writes Sir Thomas Oliver, "the vital resistance of the organ-

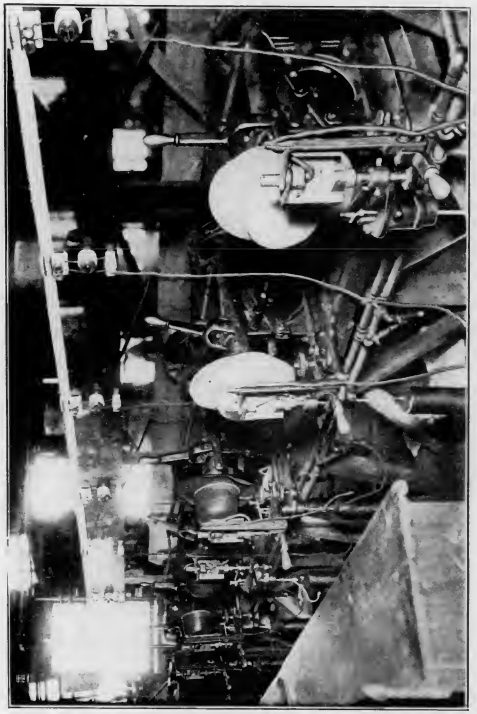

PLATE XXIX.
A Line of Electric-Heated Crown-Ironing Machines.
Courtesy of E. V. Connett & Co.

ism is reduced and the way paved for disease. * * * In larger quantities it causes symptoms of poisoning such as headache, vertigo and buzzing in the ears. * * * Three per cent of carbon dioxide in the air causes difficulty in breathing; six per cent causes palpitation and headache; while upward of ten per cent induces unconsciousness."

All these health-risks are obviated by the substitution of electricity for gas as a means of heating the crown-ironing machines, as well as the individual hand-shells used at the bench. Where such change has been made the results are economical and universally satisfactory.

Wherever the use of gas is continued in the Front Shop, the Department requires efficient exhaust ventilation by means of wall fans, or center-hung windows, or other devices to insure sufficient air exchange to protect the health of the worker.

One important argument against the use of the gas-shell is the resulting fire-hazard. The finishing-room is usually an ideal spot for a smoldering match to work mischief. It is almost the only trade-process now existing which permits the workers' uncontrolled use of matches in the work-room; and in buildings of old-type wooden construction, insurance rates are often influenced by this fact.

BRIM IRONING. (While one finisher's method of procedure may differ from another's, the following description covers the general treatment of a soft felt hat.)

After it is removed from the crown-ironing machine, it is lightly pounced with a piece of fine emery-paper to remove the shine resulting from the iron (this hand-pouncing does not require exhaust): is given a dash of steam to even the color, and is then greased by means of a hot cotton pad and crude oil, (vaseline and cocoanut oil are also employed, the former on light hats). An inch-wide rubber band is then slipped over the crown to hold it firm on the wooden block, the cord taken off, the upper brim dampened by means of a wet brush, and ironed smooth with a hand-iron or "shell." (Gas-poisoning from the hand-shell is an even more direct menace than from the machines, owing to the fact that while working at the bench, the finisher is always near or immediately over it.)

After the upper brim has been properly smoothed, the under is wet and pressed in the same manner; and both sides are pounced (either before or after "rounding"), and the shine removed with a piece of emery-paper held over a shaped piece of rubber or wood known as a "rubber tallacker." The rounding-jack (that cuts the brim as it is run around the crown) is a sharp knife mounted on a graduated device which permits adjustment to any desired width. If there is a flare or variation at front and back, a narrow leather pad called a "strap" is pressed against the crown so that the "rounding-jack" takes an extra depth in passing by it. The upper and under brim are also greased, and the band about the crown is replaced by the cord tied (singly this time) close to the inner brim where it meets the block.

SURFACE FINISHING. At this point the methods depend upon the color and quality of the felt, as well as the special standards of the firm in question. A dull or high lustre may be desired; a blue or jet black; a slight toning of a pearl or buff, or the hundred variations dependent on the skill of the finisher.

On a typical black hat there is another pouncing of the crown; a light greasing; and a deft "back stropping" with the palm of the finisher's hand, supplemented by another pouncing with an older and worn-down piece of emery-paper; and a dash of steam followed by a naphtha-singe. While this singeing process removes all traces of excess fur-fibre, its especial value for a dark felt is in evening up the color. (On light felts the alcohol singe may be employed: they are also "flued" with a damp sponge and dried on steam-coils.)

It should be noted that the fumes from the naphtha singeing operation are offensive and call for removal. This is accomplished by enclosing the singeing-flame inside a metal hood open only on the front, of sufficient size to permit the introduction of the hat, and connected to a stack or direct outside ventilation by means of a pipe (with a damper) not less than 12 inches in diameter. (See Plate XXX.)

After singeing, the hat is thoroughly slicked up with a clean cotton pad, or with the palm of the hand; it is capped with a piece of brown paper to protect the crown from subsequent handling in the trimming room: the cord is taken off, and its mark removed with the tip of the iron; the label or labels pasted in; and the finisher's labors are at last over.

The question of "lining," "slicking-up" and "stropping-down" are too varied to admit of specific cataloguing. A good finisher is something of an artist in his line, and can give individual distinction to the hat he turns out, if the details can be trusted to his judgment.

SANITATION. The health problems of the finishing-room are practically confined to excessive heat, bad air, and dust conditions; including those resulting from the practice of "powdering" the cheaper grades of felts.

As has already been explained, the substitution of electricity for gas goes far toward meeting the first two difficulties; and "good-housekeeping" is essential to correct the last named.

Vacuum cleaning is a necessity in the Front Shop: as the dry sweeping up of pouncing-dust, and gathering up of roundings, is most unsanitary if practiced during working hours, and should be prohibited.

If the dust is collected before it becomes tracked about the room, and if adequate natural or mechanical exhaust ventilation is provided, together with the elimination of steam, gas and naphtha-fumes, the finishing-room should furnish a clean health-record, in contrast to the heavy physical price listed against this department in the majority of the old-type factories.

PLATE XXX.

A Natural-Draft Singeing-Hood to Carry off Naphtha Fumes.

Ridgway Co. Courtesy of E. V. Connett & Co.

STIFF HATTING.

FINISHING. The introduction of machinery has greatly changed the processes in the Front Shop. While hand work still persists in some of the finest grades of hats, the majority are turned out with the aid of mechanical means, which in most instances lessens the labors of the finisher.

BLOCKING. It should be noted that where press-finishing is employed, the stiff hat, unlike the soft felt, requires great care in the initial blocking. Instead of leaving the blocker's hands with merely a crown and brim to give evidence of its treatment, the stiff hat must be shaped on a block (a counterpart to the mould of the press) so that it will not require any alteration of line before its finishing.

PRESS FINISHING. The hat is first placed in a steam-heated oven to soften. It is then put (crown downward) into the mould of a hydraulic press. A thin steel plate, open in the centre to the size of the hat, is laid upon the brim, and a heavy iron section (containing an inverted hat-shaped rubber bag that just fits into the crown) is shut down and fastened. Cold water is forced into the bag at a pressure of 400-500 lbs.; and after a moment or two, when the pressure has been released, the cover is lifted, and the cooled, stiff, perfectly blocked and smoothly pressed hat, can be lifted out. It is then put on a block; set upon a revolving lathe; and the surface is brought to a satiny finish with emery paper, and by means of a "lure" consisting of a greased cotton pad.

The especial advantage of press-finishing over hand-work is that all imperfections or inequalities are pushed inwards, leaving a smooth surface for the finisher.

It should be borne in mind that the ovens (in which the hats are softened preparatory to pressing) give off considerable heat; and that therefore good natural, or exhaust, ventilation is required in those departments where this kind of work is carried on.

The same result as press-finishing is achieved by hand-work. In this case, the hat is held over a live steam pot until it can be pulled into final shape over the block; it is then dried; may receive an extra coat of water stiffening on the inside; be again dried, reblocked, and both crown and brim ironed to remove all unevenness. It is then hand-pounced with emery paper; singed, "lured" with oil or grease, and—as in the case of the quicker press-finishing—be ready for the final operations of curling and trimming.

ROUNDING. A metal plate, the exact graduated width of the desired brim, guides the machine "rounder" that cuts off the excess edge, and prepares it for curling.

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ROUNDING. A metal plate, the exact graduated width of the desired brim, guides the machine "rounder" that cuts off the excess edge, and prepares it for curling.

HAND CURLING OR SHACKLING. After the bodies are rounded, the edges of the brims are softened by means of a hot iron and water, and the edges turned over with hot metal tools known as shackles. After the desired width of curl has been turned over, the edges are made perfectly even by means of a small hand plane, or shears. They are then allowed to dry naturally; after which the hats are placed on a hot steam-plate to soften the brims, so that the operator can manipulate the same into the desired shape.

MATRICING. The curling operation can be accomplished more quickly, and, according to some authorities, more uniformly, by the use of metal matrices (of somewhat similar construction to the press-finishers) and hydraulic pressure. The matrices are so made that they give to the brim the final and permanent shape of the hat.

After the hat is curled, a thin wire, shaped to fit the hat, is inserted under the curl to help hold the brim in position; after which it passes to the trimming room, where the bands, bindings and leathers are attached, which are the final operations in completing a finished hat.

These details offer no especial health-hazards, beyond that of excessive heat and vitiation of the air from the plates used in heating the shackles, and in softening the brims before matricing.

TRIMMING DEPARTMENT.

(WOMEN EMPLOYEES.)

Every hat that reaches the hands of the forelady to be weighed-out, carries a paper slip of instructions as to the style to which its final details must conform. While (as in the case of the Finishing Room) methods of procedure may vary according to the quality of goods handled, the average soft hat passes through certain standard processes before it is ready for shipment to the retailers.

TRIMMING. The color and width of ribbon band and bow specified in the instructions are deftly sewed in place by the trimmer; who, however, leaves the lower side of large bows untouched, so that they may easily be turned back in the subsequent flanging operation. The trimmer also bastes in the shaped satin lining (or tip) prepared for her by another operative known as the "tip maker";—provided that somewhat luxurious item is required by the style in question. (See Plate XXXI.)

Next in order is the fitting of the sweat leathers, which come to the trimmer ready for adjustment; (it may be noted that only two factories employ special fitters for this purpose) and their style, color and quality may also vary according to directions. They have been cut by men operatives from a superior grade of imported sheep skins; stamped in gold or silver leaf with the name of the manufacturer or the retailer; and ordinarily have been machine-stitched by women operatives to a narrow band of oil-silk enclosing a fine flexible reed. If this style be used, the trimmer fits it; joins the edges by means of a "sticker" (strip of gummed muslin) pasted on the back; sews on the tiny inside bow that forms the finish; sticks on the size-mark, and then proceeds to sew in the leather by hand through the edge of the oil-silk that encloses the reed.

If a plain leather is used, however, the trimmer only fits and finishes it; sending the hat to a special operative, who whips it in by means of the machine which has eliminated hand-work for this detail.

BINDING. The brim may reach the "binder" either curled or uncurled, according to instructions; and the variety of styles called for by changing fashions commonly renders her task one of the least monotonous in the Trimming Room.

Where ribbon binding is employed, it may be either "Even" (the same width both sides, and put on with one machine-stitching); or "Wide Upper" (narrow on the under side and requiring two stitch-

PLATE XXXI.
A Typical Trimming Room.

Courtesy of Mallory Hat Co.

ings); or "Wide Under" (which merely reverses the appearance and the stitching operation). The "binder" does not herself turn in the raw ends of the ribbon, but completes the stitching after another operative (called a "snapper") has brought the ends together, fitted and stitched them, and returned the hat to her to finish the two inches left free for the "snapping" operation.

WELTING. The variety of welts is even greater than that of ribbon bindings. The stitched welt is commonest; and in its 1/8, 1/4, 3/8 or 1/2 inch form may call for from one to three rows of machine stitching. This may be on the upper or under brim, according to the public's fancy; or there may be a narrow hand-whipped welt; or the edges may be left raw.

HEALTH STANDARDS. The Trimming-room is universally the most attractive department in the felt hatting trade. While ventilation is sometimes inadequate, few such rooms in the industry are other than well lighted and cheerful.

Investigation has shown, however, that owing to old-type construction, toilet facilities are too often inadequate or unsanitary; washing arrangements below standard; and that the dressing and lunch rooms, especially necessary for women employees, are either absent or cheerless. These disadvantages to health and efficiency are being changed as rapidly as trade conditions permit; and the sanitary standards set by the Department are also in force for women employees.

Attention is called to the mechanical hazard offered by the shafting of the power-driven sewing machines in the Trimming-room. Serious and even fatal accidents may result if this is not protected, as has been demonstrated in cases where girls have stooped to pick up rolls of ribbon, or other objects, and sleeves or loose ends of hair have been caught.

CURLING.

After inspection and passing by the forelady, the raw edges go to the curling machine, or to be "shackled." The latter operation, performed by male workers, consists in turning over the dampened edge of the brim with a small hot metal tool; but as this is hand-work it is only employed on the best grades of hats. The great majority of edges are curled by passing through a gas-heated device, which can be graduated by the operator to produce any desired width; after which the edges are skillfully trimmed with a pair of shears, leaving an even, clean-cut finish.

In many cases the hats go direct to the curling-machine from the finisher, and from there to the trimmer and binder; the latter of whom either stitches down the curled "welt," or binds them with ribbon, as has already been described.

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FLANGING.

The last of the many operations through which it passes before the finished hat reaches the hands of the retailer is that of "flanging." This not only "sets" the curl, but also gives the desired curve to the brim by means of heat; and on this final operation depends much of the individual style that distinguishes one season's hat from that of the preceding year's. (See Plate XXXII.)

The "flanger" first removes the paper cover from the crown; then slipping the trimmed hat inside a hollow wooden "flange" or brim-mould of the required pattern, he adjusts the edge; covers the whole with heavy canton flannel held in place by a cord tied around the rim; dampens the edge with a sponge; presses it with an electric or gas-heated iron; and then placing the flange on a wooden block, lowers over it a canvas-bottomed flange-pan filled with sea sand, the contents of whose bag has been heated to a high temperature on the steam-plate upon which it rests between the flanging operations. After several minutes the brim has "set"; and after brushing and inspection, the hat is ready to go to the shipping department to be "nested" and packed in paste-board boxes. If, however, the lower edge of the bow has been left free and turned back to facilitate the flanging operations, the hat must once more go to the trimmer for a few stitches, before it completes its journey to the packing-room.

While the gas-heated curling machines may vitiate the air by combustion or gas leaks (no satisfactory electrical device has yet been perfected) the greatest menace to health is the excessive temperature generated by the steam-plates on which the flanging bags are heated. When gas irons are also used by the flangers, almost intolerable conditions often exist.

The Department urges the adoption of electric installations wherever possible, including not only electric heated shells, but also flanging-bags. Experimental tests of a type of bag whose sand is heated by inside coils of electric wire have been so satisfactory that several firms are prepared to adopt their use in the near future. Where such a solution of the heat-problem is not practicable, the Department requires efficient mechanical exhaust ventilation in those flanging departments where overhead construction does not permit satisfactory roof ventilation. It also endorses the recent experiment by a Newark firm which has proved that much of the heat radiated by the steam-plates may be controlled by means of an asbestos covering. This encloses the bottom and sides of the plates, leaving only the heating surface exposed; thereby diminishing by one half the amount of steam required to keep them at the necessary temperature, and also proportionately reducing the heat in the work-room.

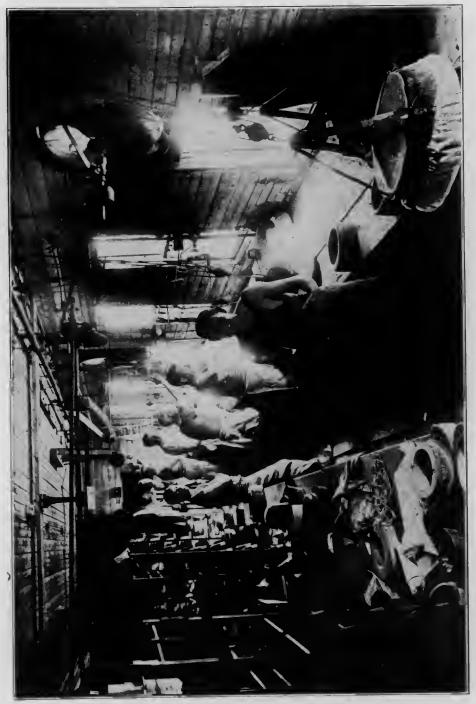

PLATE XXXII.
Flanging-Room Ventilated by Wall-Fans, and with Flanging-Plates Covered on Bottom and Sides with Asbestos.
Courtesy of H. V. Connett & Co.

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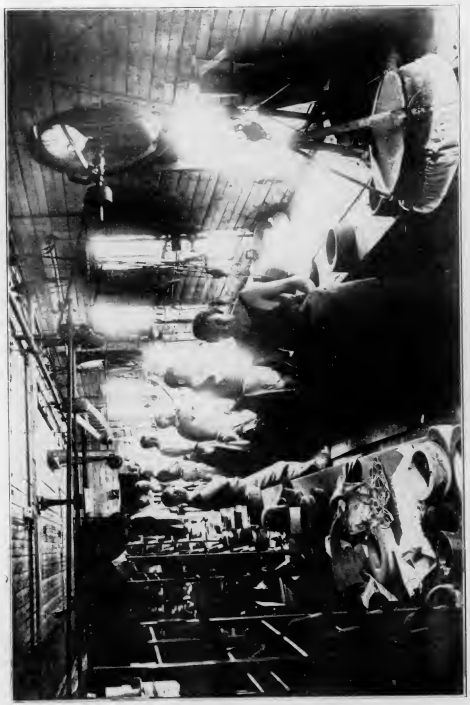

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SANITARY AND WELFARE PROVISIONS.

BACK AND FRONT SHOPS.

TOILETS. Since the felt hatting industry comes within the category of those trades which subject their workers to heat and humidity, the Department cannot too strongly emphasize its position regarding the necessity for ample sanitary facilities.

In factory construction it is important that the toilets be under the same roof as the employees who use them, and that there be no exposure to inclement weather involved in reaching them.

The ideal toilet arrangement, for either women or men, is an individual enclosed booth that gives perfect privacy to the user.

In the case of male workers, a method that has been widely adopted is to have a range with individual seats and closed sides, but open in front. This type of range flushes automatically, and at as frequent intervals as may be desired. (See Plate XXXIII.)

Whatever the type of installation, a minimum of at least one toilet-seat should be provided for each twenty persons, or fraction of that number.

All toilets intended for the use of women must be absolutely separate from those for men; and both must be provided with vestibules which give entire privacy to those within.

In all cases toilets must be provided with efficient outside ventilation by means of a window, or windows, opening directly to the outer air.

Provisions should be made for heating toilet-rooms during the winter; and at all seasons of the year the plumbing arrangements should be kept in working order, and the toilets should be regularly cleaned at the close of the day's work.

WASHING FACILITIES. The change in sentiment regarding sanitary requirements, both on the part of employers and employees, has become so marked during the last decade, that it is no longer necessary to plead for these obvious necessities for conserving and promoting health-efficiency.

While there are various types of washing-facilities, there is a certain minimum standard (based on the time involved in the operation of washing-up) which has been widely adopted abroad, and in a dozen of the lead-trades in this country.

In accordance with this standard, the Department points out the advantages resulting from the provision of one hot and one cold water tap for each five persons. In connection therewith there may

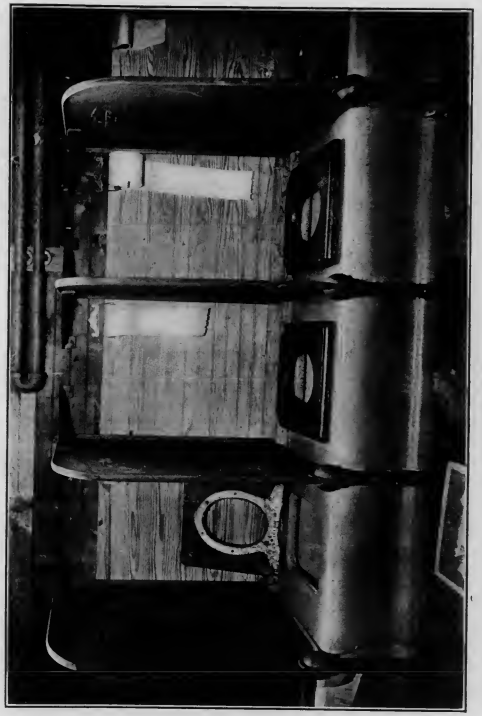

PLATE XXXIII.
A Range of Automatically Flushed Toilets for the Back Shop.
Courtesy of No Name Hat Mfg. Co.

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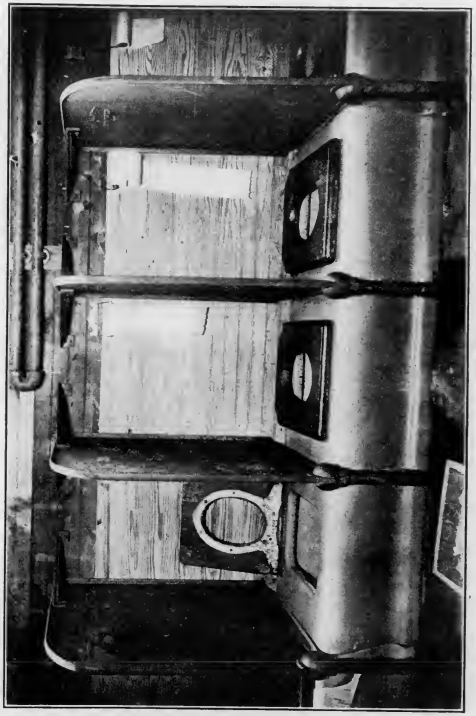

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A Range of Automatically Flushed Toilets for the Back Shop.
Courtesy of No Name Hat Mfg. Co.

be fixed individual wash stands with sewage connection, or iron or enameled troughs (with sewage connection) in which individual hand basins may be set, a hot and a cold water tap being apportioned to each two feet of trough; or iron or enameled troughs with sewage connection but *without plugs* (one hot and one cold water tap to each two feet thereof) through which the water flows freely and is at no time stagnant. The Department cannot too strongly condemn the practice of workers washing in a common trough, through which there is not *a continuous rush of water* with all water taps open. One of the most satisfactory arrangements for heated workers is to have the water-supply pipe elevated some 24 inches above the trough; and the taps or line of perforations so arranged that the water cascades out of them. This enables the worker (after removing his shirt) to wash the entire upper portion of his body. Heated water to any desired degree may be obtained by running a steam-jet (by means of a by-pass) into the cold water supply pipe.

Unless sanitary containers for liquid or flaked soap are provided, each worker should be supplied with individual cakes.

The Department approves the furnishing of individual towels to the workers; and condemns as unsanitary, and a distinct menace to health, the common use of the roller towel.

DRESSING ROOMS. The Department requires that a dressing-room or rooms shall be provided for the entire working force. These must be separate for women and for men, where both sexes are employed; and must be well ventilated, kept in sanitary condition, and be heated in cold weather.

Each worker should be provided with a metal locker containing two compartments, one of which may be used for street clothing, and the other for working clothes. These lockers should be of solid construction excepting the front, which may be of wire-mesh or of solid construction with fluted front.

While the double-locker is the ideal type for trades where the workers are subjected to heat and humidity, the Department will accept, in lieu of this, a single metal locker of similar construction. This locker must be at least 60 inches high by 15 inches wide, and 12 inches deep.

Owing to the fact that the working-clothing of male employees in the felt-hatting trade is usually wet when hung up at night, too great stress cannot be laid on the necessity for proper ventilation of the lockers and of their contents.

SUMMARY OF SANITARY STANDARDS.

To make felt hat manufacturing a safe and sanitary occupation, shops should observe the following requirements:

1. All mixing should be done mechanically in an enclosed device. There should be no layering-down or mixing in the open.

2. The fur-mixture should be fed into the "Devil" by means of an enclosed automatic device.

3. The "Devil" should be tightly housed and the feed-opening properly safeguarded.

4. All settling-chambers should be rendered as dust-proof as possible by means of cheese-cloth coverings over the necessary wire-mesh openings.

5. All boxes containing fur-mixture should be kept tightly covered during transportation or while standing in the work-room.

6. All blowing machines should be fed by means of an automatic device: and all dust and fur fibre liberated during the blowing and cleaning operations should be removed from the air of the work-room either by means of the exhaust system standardized in the Bulletin, or other approved and equally efficient device.

7. Vacuum or wet cleaning only should be employed in the dusty departments: and no dry sweeping during working hours or cleaning by means of compressed air should at any time be permitted.

8. The temperature of the blowing room (when due to artificial heat) should not be permitted to exceed 75°, and when live steam is employed to increase the humidity, excess temperature should be prevented by means of a cold water spray, or other efficient device.

9. Fourteen feet should be the minimum height of ceiling in all mill forming-rooms where the feeder stands on a raised platform at the rear of the forming-machine. When the ceiling is lower than this requirement, the platform should be lowered, and a double inclined apron attachment to the forming machine or other device be adopted.

10. The temperature of the mill-room (when due to artificial heat) should not be allowed to exceed 75°; and when live steam is employed to increase the humidity, excess temperature should be prevented by means of a cold water spray or other efficient device.

11. All steam generated in the operations of starting, first and second sizing, dyeing and blocking should be controlled and eliminated by means of efficient mechanical exhaust ventilation, such as have been standardized in the Bulletin.

12. Wherever factory construction permits, all kettles should be emptied through closed drains to central traps with convenient clean-outs, and thence to the sewer. In all shops where the contents of the kettle is pulled and allowed to flow over the floor or in open drains, substantial wooden floor-gratings should be provided.

13. Fixed pegs should not be permitted in any drying room which must be entered while hot by the worker. Unless it is the invariable custom of a factory to only turn on steam outside of work hours,

movable racks or other devices are required, and the dry-room should be of a type standardized in the Bulletin.

14. Wood alcohol fumes should not be permitted to pollute the air of the workrooms either during the shellacing or drying operations. Efficient means for their removal should be installed, and care exercised to safeguard against the hazard of explosion.

15. All dust generated in the operation of pouncing and sand papering machines should be controlled and eliminated by means of the efficient mechanical exhaust ventilation standardized in the Bulletin.

16. All steam-pots and singeing-flames should be hooded and have direct connection to the outer air by means of pipes not less than 12 inches in diameter, with efficient natural draft ventilation.

17. All hand or mechanical ironing shells should be heated by means of electricity. Wherever gas is employed for ironing purposes, the health of the worker should be safeguarded by means of efficient mechanical ventilation.

18. When the grade of hats handled makes powdering necessary, the dust generated should be drawn away from the workers by means of efficient exhaust ventilation.

19. To control the excessive heat generated in the flanging and matricing operations, ample ventilation should be provided by means of windows, wall fans, or other devices; all steam plates should be covered on bottom and sides with asbestos to prevent direct radiation: and wherever possible an electrical device for heating the flange-bags should be installed.

20. There should be daily gathering up of all waste; and only vacuum cleaning of dry departments should be permitted during working hours.

21. There should be separate washing facilities for men and for women, with hot and cold water; and separate dressing-rooms, lockers, modern toilet accommodations, and pure, cool, drinking water, preferably bubbling fountains.

22. Standard safeguarding should be installed on all shafting under power-driven sewing machines, and on all belts, gears and wheels; and all set screws should either be removed or countersunk.

APPENDIX.

MERCURY POISONING IN THE FELT HATTING INDUSTRY.

Since the adoption of the use of nitrate of mercury in the preparation of hatters' fur, not only have those employed in carrotting and subsequent fur-cutting processes been liable to mercurialism, but also a large percentage of felt hat workers in almost every department of the trade. This is due to the fact that mercury volatilizes at the ordinary temperature of the work-room; and that it is absorbed by the system either in the form of direct fume; or by the inhalation of impregnated fur-dust; or by skin absorption in the various wet operations of the plank shop.

While the number of mercury-using trades is limited, none has escaped paying physical toll to the subtle poison. Mercurialism became so common among the workers engaged in silvering mirrors in Furth and Nuremberg, that the stringent sanitary regulations drawn up by the authorities eventually drove the process from Germany. Since 1893 France has prohibited the employment of women and children in hatters' furriers' shops where pelts are treated with a carrotting solution: and England and Germany have adopted scientific protective measures to safeguard the health of those workers who are in any way exposed to industrial mercury hazards. That those employed in mining the metal commonly fall victims to their employment has long been recognized. There is scarcely a break from the tragic records of 1665 dealing with the "shakes" afflicting the convicts in the quicksilver mines of Almaden, Spain, down to our own XIth Census Report, which calls attention to the fact that in one year (1890) no less than 10 per cent of the miners of New Almaden, California, were suffering from mercurialism.

SYMPTOMS RELATING TO THE MOUTH AND ALIMENTARY CANAL. Ulceration of the gums, attended by fetid breath and excessive salivation, is one of the commonest symptoms of mercurial poisoning. Particularly is this true of workers in the fur cutting shops where they are directly exposed to the strong fumes of nitrate of mercury. Dr. Legge writes: "The typical appearance in the teeth of those who are engaged in "carrotting" (that is brushing the rabbit skins with the dilute acid solution for several years) is loss of the molar teeth in the upper and lower jaws. The upper incisor and canine teeth are not infrequently absent, and such teeth as remain are characteristically blackened and often loose. They show a marked tendency to erosion from the acid fumes, and frequently the gums recede so that the anterior surfaces of the roots are exposed.

Few combinations can be imagined more likely to affect detrimentally the health, and more particularly the teeth of workers, than that of mercury and nitric acid. Those engaged in carrotting show in most marked degree injury to the teeth from the nitric acid fumes; while tremor (the nervous affection) predominates in the later processes as the result of the inhalation of particles of fur impregnated with the nitrate of mercury."

The following figures make this clear, giving the results of an examination made by Dr. Legge of 111 persons in eight different factories, who had worked for one year and upwards:

Process.	Number Examined.	Bad Teeth.	Per Cent.	Tremor.	Per Cent.
Carrotting	30	20	66.6	1	3.3
Other Processes	81	27	33.3	17	21.0

The harmful character of nitrous fume (apart from its combination with mercury) must also be noted, because of its injurious effect upon the tissues of the throat and lungs. Direct exposure may even lead to fatal consequences. As far back as 1829 Dr. Reitz, of St. Petersburg, published a monograph on the deaths from acute bronchitis of three hatters' furriers, who had been exposed to poisoning from nitric acid while mixing a carrotting solution.

SYMPTOMS AFFECTING THE NERVOUS AND MUSCULAR SYSTEMS. The symptom of mercury poisoning for which most sufferers first seek medical advice, however, is muscular tremor; or (as it is known to the trade) "Hatters' Shakes." According to Dr. Tylecote, "the tremor is, as a rule, first noticed in the arms or hands. In cases in which the tremor rapidly becomes general, the speech is often affected. Occasionally a fine tremor of the eyelids can be noticed; and others when asked to show their teeth, or in the act of speaking, bring out a well marked tremor of the lips and lower part of the face. The tongue may show it also. One man said his tremor was always worse when he was cold. It is usually increased on voluntary movement; it stops during sleep, and when lying down it is much less marked."

Dr. Legge points out that "although in industrial mercurial poisoning, the symptoms occasionally resemble those which result from the internal administration of full doses of mercury, * * * they are as a rule much slower in their onset, and more insidious in character. For years the only sign may be more or less gastric disturbance; a gradually increasing anæmia; a slight increase in the secretion of saliva with tendency to ulceration of the gums; and slight tremor of the muscles of the face and hands, accompanied by a certain amount of nervousness. * * * The worker becomes pale and loses his appetite. He frequently has headache, giddiness, and transitory pains in the limbs. The mental condition undergoes

change. Workers assured of their skill become shy and nervous, especially when watched. Sleep is often interfered with, and broken by nightmare.

"In the second stage of tremor, disturbance of the muscular system preponderates. It is observed principally in the muscles of the face, hands and arms; more rarely in the legs. Gradually the tremor advances until the movements become convulsive in character, and the hand cannot be directed with certainty to any particular object. The speech, from the involvement of the muscles of articulation, becomes slow and indistinct. The psychical condition changes to one of depression or despondency. There may be hallucinations, loss of memory, and dullness of the intellectual faculties. In women, menstruation is diminished or ceases. Miscarriage is frequent, and the offspring is liable to be the subjects of rickets or scrofula."

The final stage is characterized by malnutrition and general bad health, the poisoned worker exhibiting a waxy and sallow complexion, as in cancer, tuberculosis, or the like. "Chronic mercurial poisoning does not frequently lead directly to death. It appears to lower the vitality of the tissues markedly; and Kussmaul calls attention to the frequency with which mercurial workers die of tuberculosis of the lungs."

INDUSTRIAL TUBERCULOSIS IN THE FELT HATTING INDUSTRY.

Pitiful as are the physical effects of mercury poisoning, the great scourge of the felt-hatting shops is induced tuberculosis of the lungs. For generations not only has the trade itself paid the price for its unsanitary character, but factories have unknowingly become centres of infection, from which the bacilli of tuberculosis have been carried by diseased workers, and thus spread through a constantly widening area of the community at large.

Industrial tuberculosis differs from ordinary consumption in that the lung tissue of the worker has been almost automatically prepared for infection by the physical condition arising from daily subjection to irritating dust, or in a less degree, to fumes, excessive heat, or humidity. As an injurious factor, dust (either vegetable, animal, metallic or mineral) is first; and its inevitable relation to trade mortality has been treated at length by the statistical authority, Frederick L. Hoffman, in Bulletin 79 of the Department of Labor and Commerce.

In his Mortality from Consumption in Dusty Trades, he says in part: "The importance of dust as a factor in occupation mortality has attracted the attention of every authority on occupation diseases from Ramazzini to Thomas Oliver. It requires no extended consideration to prove that human health is much influenced by the character of the air breathed, and that its purity is a matter of very considerable sanitary and economic importance. * * * Apart from the transmission of disease through a dust-contaminated atmosphere, dust in any form, when inhaled continuously and in considerable quantities, is prejudicial to health because of its inherent mechanical properties, destructive to the delicate membrane of the respiratory passages and the lungs."

Quoting Sir James Crichton-Browne, he continues: "The mortality of the principal dust-producing occupations, compared with that of agriculturists, who live and work in what is practically a dustless atmosphere, is excessive to a startling degree. It is not suggested that this excess is to be ascribed to dust alone, no doubt various factors contribute to it; but the facts that it is due mainly to respiratory diseases, that it is distributed amongst the several occupations pretty much in proportion to their dustiness, and that it has diminished in some instances where dust has been effectually dealt with, justify the conclusion that it is largely dust begotten."

"Pulmonary disease" (according to the report of the British Departmental Committee on Compensation for Industrial Diseases) manifests itself in three kinds of forms—as ordinary tuberculous phthisis, acute or chronic; as "fibroid phthisis," and as a mixed form when a tuberculous process is ingrafted sooner or later upon the fibroid. Fibroid phthisis is always a slow disease. It consists in a chronic reactive inflammation around the many minute foci of dust inhalation, which by coalescence gradually invades larger areas, impairing and strangling the proper lung tissues in corresponding measure. Again, a lung so impaired is very apt to harbor bacilli, especially the bacilli of tubercle, by the influence of which it may be still further destroyed. Thus both fibroid phthisis uncomplicated, and fibroid phthisis with the supervention of tubercle, are in their nature occupational disease.

"The first symptom (of fibroid phthisis) is a cough which insidiously, and for a while almost imperceptibly, becomes habitual. At first in the morning only, it gradually becomes more frequent during the day; and expectoration, nominal at the beginning, becomes more marked, though not profuse until the latter stages of the disease. Leaving out of account the more rapid progress of the disease in tin and gold miners, these symptoms of a negative phase of purely local damage may last for years—ten or fifteen or even more—without advancing to such a degree as to throw the workman out of employment or even to cause him serious inconvenience. At some period, however, rarely less than ten years and frequently more than twenty, of continuous employment, in a like imperceptible manner the breathing gets shorter, and the patient finds himself less and less capable of exertion. Yet, even when the cough and dyspnoea have reached a considerable degree, there are no signs of fever, as in the case of pulmonary tuberculosis; the flesh does not fall and the muscles retain their strength and volume. Thus even at a period when the malady is fully established, the general health may be but little impaired, and the patient may not be compelled to cease work. Herein fibroid phthisis presents a well-marked difference from pulmonary tuberculosis; and even if, as we have said, the disease becomes complicated with tubercle, yet the rate of progress may be determined rather by the character of the primary than of the secondary disease, though usually the supervention of tubercle hastens the sufferer into a more rapid consumption."

How fatalistic those engaged in dusty industries often are to the evils which they have always associated with their work is pointed out by Dr. J. T. Arlidge: "What occurs to the ordinary citizen in regard to exposure becomes magnified ten or a hundred fold to those engaged in dusty occupations; and more especially where the dust itself possesses noxious properties (as does the mercury laden dust of the hat shops.) But unless dust has this latter quality, it is remarkable with what indifference its inhalation is treated by the majority of workmen. In one sense, indeed, it is unfortunate that it

does not, for the most part, awaken attention by immediate tangible consequences. Its disabling action is very slow, but it is ever progressive; and until it has already worked its baneful results upon the smaller bronchial tubes and air cells and caused difficulty of breathing, with cough and spitting, it is let pass as a matter of indifference—an inconvenience of the trade."

While fibroid phthisis is commonly slow in its action, direct infection and rapid development of pulmonary tuberculosis is also characteristic among hatters exposed to fur dust, especially those in the pouncing-room.

The fatal results may be judged from the table below giving the experience of the Prudential Insurance Company from 1897 to 1906, first published in connection with their exhibit at the International Congress on Tuberculosis held in Washington in 1908.

The figures may be explained briefly as follows: Between the ages of 25 and 34, out of every 100 deaths from all causes in the registration area of the United States Census during the seven years ending 1906, 31.3 deaths were from consumption. The corresponding proportions of deaths in the industrial insurance mortality experience were 38.9 for furriers and taxidermists, and 55.4 for hatters.

PERCENTAGE OF DEATHS DUE TO CONSUMPTION

Age at Death.	All Males in United States.	105 Furriers and Taxidermists.	832 Hatters.
15 to 24 years	27.8	33.3	53.8
25 to 34 years	31.3	38.9	55.4
35 to 44 years	23.6	63.3	45.4
45 to 54 years	15.0	30.8	26.7
55 to 64 years	8.1	8.3	14.8
65 years or over	2.7	5.9	.8
Total	14.8	32.4	33.4

The Benefit Societies of the trade itself also furnish convincing data as to the alarming prevalence of tuberculosis of the lungs among its members.

SEASONAL CHARACTER OF THE TRADE.

In judging of the morbidity and mortality statistics of the felt hatting industry, it should be borne in mind that practically no worker is employed twelve months of the year. While enforced periods of rest are a financial hardship to the trade as a whole, investigation shows that from a health point of view these normal intervals of freedom from mercury and dust hazards are physically beneficial to the workers. The cumulative effects of mercurialism are thereby diminished or delayed; and even such temporary removal from irritating dusts lengthens the resistence of the victims of tubercular infection, and proportionately decreases the incapacity of those afflicted.

ECZEMA IN THE FELT HATTING INDUSTRY.

In his book on "The Occupational Diseases," Dr. W. Gilman Thompson (in addition to his valuable investigations of the mercury and tuberculosis hazards of the trade) notes the fact that a pustular type of eczema, attributed to the effects of the dried carroting solution adhering to the fur fibres, is sometimes found among felt hat makers.

There are also records of early epidemics of eczema impetiginosum from handling infected foreign fur; and scattered cases still occasionally occur, although at infrequent intervals. "The victim," writes Dr. Thompson from his record of a typical case, "suffered from intolerable burning and itching of the skin. The blebs became purulent and sanguineous, and superficial ulcers formed with areolas of dermatitis. Staphylococcus pyogenes aureus was isolated from the pus. The man was finally obliged to give up work and seek hospital relief, where he improved under vaccine treatment."

Infection of wounds is also common among those handling raw pelts in the preparation of hatters' fur.

STANDARDS OF HUMIDITY.

The results of recent experiments in the blowing and mill rooms have proved that requisite humidity may be attained without the excessive heat usually permitted in these departments. Since a relative humidity of 65°-75° in winter, and 55°-65° in summer is sufficient to ensure satisfactory blowing and forming of the fur, it is essential that the foremen in these rooms should be provided with some simple method of finding out the daily relation between the temperature and the amount of moisture in the rooms under their charge. While the relative humidity may be read directly from a hygrometer, a wet and dry bulb thermometer may be used to advantage, provided it be fanned, or a current of air be directed upon it while the record is taken.

The following table explains a simple method of ascertaining the contents of moisture in the air of the work-room:

RELATIVE HUMIDITY.

(By means of wet and dry-bulb thermometer.)

Wet Bulb.	Difference Between Wet and Dry-Bulb.												
F°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°
35	90	80	71	63	56	48	42	35	30	24	19	14	10
40	91	83	75	67	60	54	48	42	37	32	27	23	19
45	92	85	77	71	64	59	53	48	43	38	34	30	26
50	93	86	79	73	68	62	57	53	48	44	40	36	33
55	93	87	81	76	70	66	61	57	52	48	45	41	38
60	94	88	83	78	73	68	64	60	56	52	49	45	42
65	94	90	84	79	75	71	67	63	59	56	52	40	46
70	95	90	85	81	76	72	69	65	61	58	55	52	49
75	95	90	86	82	78	74	70	67	64	61	58	55	52
80	95	91	87	83	79	75	72	69	66	63	60	57	54
85	96	91	88	84	80	76	73	70	67	64	62	59	56
90	96	92	88	85	81	78	75	72	69	66	63	61	58
95	96	92	89	85	82	79	76	73	70	68	65	62	60
100	96	93	89	86	83	80	77	74	71	69	66	64	62

TO FIND RELATIVE HUMIDITY.

(By means of wet and dry-bulb thermometer.)

RULES:

1. Find *reading* of wet-bulb in left-hand column, and draw a line from left to right horizontally across the table.

2. Find the *difference* in reading between the wet and dry-bulb thermometers along the top line, and draw a line down vertically across the table.

3. The number at the intersection of these lines gives the per cent of relative humidity.

EXAMPLE:

Find per cent of relative humidity when *wet-bulb thermometer* reads *75°* and *dry-bulb* reads *77°*.

1. Find 75 in left-hand column and draw horizontal line.

2. Difference between 75 and 77 is *2*. Find *2* in top line and draw vertical line.

3. These lines intersect at 90. Thus the relative humidity is 90 per cent.

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